Original Article

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Dentistry Section

Comparative Evaluation of Smart Dentin Replacement and its Combination with Fiber in Reinforcing Endodontically Treated Teeth: An In-vitro Study

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ABSTRACT

Introduction: Root canal treatment is essential for addressing pulp damage caused by decay or trauma. However, it significantly weakens the tooth structure, especially in posterior teeth, which endure strong chewing forces. The resulting susceptibility to fracture necessitates careful selection of restorative materials that can both protect and reinforce the remaining tooth structure. The present study explores novel restorative approaches using Smart Dentin Replacement (SDR) alone and in combination with Polyethylene Fiber (PEF) to potentially enhance the fracture resistance of endodontically treated mandibular molars, addressing the ongoing challenge of post-endodontic restoration.

Aim: To compare SDR and combination of SDR and fiber in reinforcing endodontically treated lower molars.

Materials and Methods: The present in-vitro study was conducted at the Department of Conservative Dentistry and Endodontics, Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Pune, Maharashtra, India, from June 2023 to February 2024. It included a total of 27 extracted human mandibular posterior teeth, which were collected and embedded in acrylic blocks in groups of three, with nine teeth in each group (n=9). Teeth in the experimental groups (Groups 2 and 3) underwent access cavity preparation. Group 1 consisted of intact teeth. In Group 2, the access cavities were reinforced using SDR material. Group 3 involved reinforcing the inner circumference of the access cavities with a combination of PEF and SDR. The fracture resistance of all the teeth was then evaluated using a universal testing machine. One-way Analysis of Variance (ANOVA) and post-hoc Tukey's test for intragroup comparison were used to calculate the statistical results of the present in-vitro study (p-value <0.05).

Results: The control group showed the highest fracture resistance (2178.20 N), followed by SDR+PEF (1872.57 N) and SDR (1740.40 N). The differences between all groups were statistically significant (p-value <0.001).

Conclusion: The combination of PEF and SDR material demonstrated superior fracture resistance in endodontically treated teeth compared to SDR alone. This reinforcement technique could potentially provide better clinical outcomes by enhancing the structural integrity of treated teeth, thereby reducing the risk of fracture and improving long-term success rates.

Keywords: Dental materials, Post-endodontic restoration, Ribbond

INTRODUCTION

The main role of a tooth is mastication, but fractures are a common issue in teeth that have undergone endodontic treatment [1]. Root canal procedure weakens the tooth by removing its natural protein (collagen), making it more brittle and likely to crack when pressure is applied sideways [2]. This increased brittleness is attributed to the drying out of endodontically treated teeth over time and changes in their collagen cross-linking [3]. Because of loss of collagen, which makes the tooth's dentin less flexible and more likely to break when forces are applied from different angles. The success of root canal treated teeth relies on the restoration of teeth after endodontic treatment [4]. It strengthens the teeth intracoronally to prevent fractures [5].

In traditional practice, coronal aspects of the teeth are restored with full-coverage crowns after endodontic therapy to enhance their fracture resistances [6]. Full-crown coverage is the gold standard for post-endodontic restoration, there is a need to explore more conservative and cost-effective alternatives that could potentially preserve tooth structure while providing adequate fracture resistance. Post-endodontic restoration is a frequent procedure in dental practice. Despite extensive researches on this topic, determining the most successful clinical restorative method remains challenging [7].

After an endodontic procedure, clinicians mostly recommend crown prostheses. But restoring a tooth that has undergone root canal treatment can substantial strength and resistance to fracture. This approach eliminates the need for a full-crown restoration, potentially offering significant benefits and cost savings for patients [6]. Dentin replacement is a foundational material used to line the dental cavity before applying composite resin [8]. SDR (Dentsply Sirona, Germany) is a low-viscosity flowable composite with 68% filler by weight, allowing it to reach deep areas and minimise air bubble formation [9]. SDR™ is a fluoride-containing, radiopaque composite with a compressive strength of 242 MPa and reduced microleakage [10]. Various studies proving that SDR™ can be used as post-obturation material [11-14].

Ribbond, introduced in 1992, is a bondable, ultra-high-strength PEF with 215 strands [15]. It has a high elasticity coefficient (117 GPa) and traction resistance (3 GPa), making it highly stretch-resistant and adaptable to tooth morphology and arch contours [16]. This in-vitro study was carried out to compare the reinforcing effects of SDR™ alone and in combination with PEF in endodontically treated mandibular molars, evaluating whether these advanced restorative materials can effectively enhance fracture resistance in teeth compromised by endodontic procedures.

MATERIALS AND METHODS

This in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics at Bharati Vidyapeeth (Deemed to be University) Dental College and Hospital, Pune, Maharashtra, India, from June 2023 to February 2024, after obtaining approval from the Institutional Ethics Committee (Registration number EC/NEW/INST/2021/MH/0029). A total sample of 27 human mandibular posterior teeth with sound enamel surfaces was collected.

Sample size calculation: The sample size was calculated using online tool http://powerandsamplesize.com. The effect size was calculated based on means from a study by Hiremath H et al., [17]. The derived sample size was 27 (9 per group with a power of 0.9). This random distribution aimed to minimise bias and ensure comparability between each group.

Inclusion criteria: A total of 27 non carious human lower molar teeth extracted for periodontal purposes were collected for the present study. The teeth were carefully examined using a dental operating microscope (LABOMED, Berlin, Germany) with 12.8x magnification to ensure specimen quality. Only intact teeth exhibiting no defects like fracture lines, cracks, decay, or previous endodontic treatments were selected for evaluating fracture resistance [Table/Fig-1].

[Table/Fig-1]: A total of 27 intact, non carious mandibular molars extracted for periodontal reasons.

Exclusion criteria: Teeth with enamel defects such as hypoplasia, caries, cracks, fractures, or those with previous endodontic treatment were excluded from the study.

Study Procedure

The teeth were then cleaned and stored in physiological saline until use. Afterwards, all the teeth were cleaned and polished to remove calculus and soft tissue remnants. Polishing was done using non fluoridated pumice and a prophylactic rubber cup and the teeth were then rinsed in a stream of water for ten seconds.

Preparation of teeth:

Group classifications

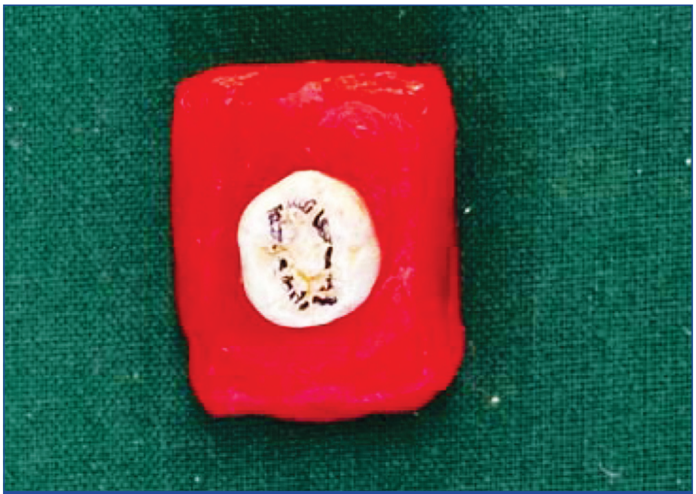
Group 1 (Control group): This group consisted of sound teeth with no treatment done. It provided a baseline for comparing the effects of treatments applied to the experimental groups.

Groups 2 and 3 (Experimental groups): Experimental specimens (Groups 2 and 3) underwent preparation of access cavities that simulated Class-1 deep dentinal decay. These preparations preserved the marginal ridges intact and maintained approximately 1.5 mm of circumferential tooth structure, as illustrated in [Table/Fig-2].

Root canal treatment: For Groups 2 and 3, root canal treatment was initiated and the canals were enlarged to size F1 using a ProTaper rotary file (Dentsply, Mumbai, India) [Table/Fig-3]. Obturation was performed using the respective ProTaper gutta-percha (Dentsply, Mumbai, India) and AH Plus (DeTrey, Switzerland) sealer, ensuring consistent and thorough canal filling across both experimental groups.

Specific treatments for experimental groups:

Group 2 (SDR™): After obturation, etching was done with 37% phosphoric acid (3M ESPE, Bengaluru, India) and 5th generation bonding agent was applied (Adper, 3M ESPE, Bengaluru, India) and cured for 20 seconds according to manufacturer's instructions.

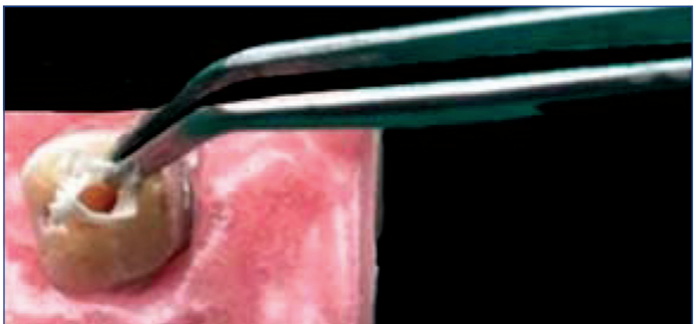


[Table/Fig-2]: Prior to creating the access cavity, the boundaries were delineated to ensure preservation of 1.5 mm of peripheral tooth structure circumferentially while keeping the marginal ridges intact.

[Table/Fig-3]: Following the completion of access cavity preparation, the tooth structure displays intact marginal ridges without compromising their structural integrity.

SDR™ (Dentsply Sirona, Belmont, Australia) was incrementally placed along the perimeter of the teeth and cured. This method aimed to reinforce the tooth structure internally using SDR™.

Group 3 (SDR™+Fiber): After obturation, the access cavities were treated with 37% phosphoric acid in the same manner as Group 2, followed by the application and curing of a bonding agent. The inner circumference of cavity was lined up with a strip of 3 mm Ribbond PEF (Ribbond Inc., United States) and a thin layer of flowable composite [Table/Fig-4]. This was then cured for 20 seconds according to manufacturer's instructions. After which, access cavity was completely filled with SDR™ material and then again cured according to manufacturer's instructions. This technique intended to combine the reinforcing effects of PEF and SDR™ [Table/Fig-5].

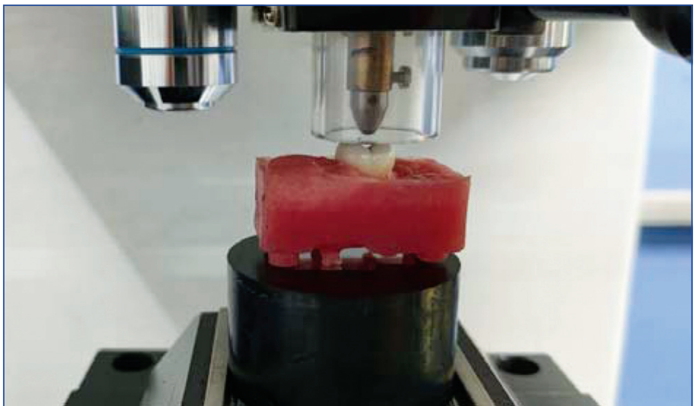


[Table/Fig-4]: A premeasured strip of Polyethylene Fiber (PEF) (Ribbond) was placed along the inner circumference.

[Table/Fig-5]: Upon finalisation of post-endodontic restorative procedures, the control group and experimental groups exhibited their completed reconstructions.

Simulating periodontal ligament and embedding: To simulate the natural periodontal ligament, each tooth was initially wrapped in aluminium foil and then embedded in an acrylic block, with their long axis perpendicular to the base. After taking an impression, the foil was removed and polyvinyl siloxane impression material was applied to replicate the ligament accurately. This set-up aimed to replicate the natural support and alignment of teeth in the jaw, thereby enhancing the study's relevance to clinical conditions.

Fracture testing: A universal testing machine (FIE UTE Series, Fuel instrument and Engineers Pvt. Ltd.) was used to test fracture resistance [Table/Fig-6]. A round-tip stainless steel rod with a diameter of 5 mm was aligned with the long axis of every tooth and placed above the occlusal surface. At a crosshead speed of 1 mm/min, the application of compression loading lasted until a fracture occurred. Compressive loading was then applied at a rate of 1 mm/min until a fracture took place. The force necessary to fracture each tooth was measured in Newtons (N). The intact mandibular molars have a mean fracture resistance of approximately 2804.5±338.5 N [18].


[Table/Fig-6]: Evaluation of fracture toughness using Universal Testing Machine (UTM).

STATISTICAL ANALYSIS

The data thus obtained were tabulated and statistically analysed using Statistical Package for the Social Sciences (SPSS) version 23.0 software, with the significance level set at 5%. A one-way ANOVA test was used to calculate the mean fracture resistance for each group, along with the statistical significance of the differences, while a post-hoc Tukey test was used for pair-wise comparisons between the groups. The level of significance was fixed at p=0.05 and any value of ≤0.05 was considered statistically significant.

RESULTS

The present study compares the fracture resistance (measured in Newtons) across three different experimental groups: the Control group, SDR™ group and SDR™+Fibre group.

The [Table/Fig-7] compares the fracture resistance (in Newton) across these groups. The Control group showed the highest fracture resistance, with a mean value of 2178.20 N and a Standard Deviation (SD) of 11.76 N. In contrast, the SDR™ group, which utilised SDR™, had a significantly lower fracture resistance compared to the Control group, with a mean value of 1740.40 N and an SD of 10.25 N.

Group	Mean±SD	p-value
Control	2178.20±11.76	<0.001*
SDR	1740.40±10.25	
SDR+PEF	1872.57±7.63	

[Table/Fig-7]: Comparison of fracture resistance (in Newton).
SD: Standard deviation; SDR: Smart dentin replacement material; PEF: Polyethylene fibre; SDR+PEF: Smart dentin replacement material along with polyethylene fibre
One-way ANOVA test; *indicates a significant difference at p≤0.05

The pair-wise comparison of the fracture resistance (in Newton) is presented in [Table/Fig-8]. The pair-wise comparisons were conducted using the post-hoc Tukey test. Compared to other two groups, fracture load in control group was significantly higher, while the fracture load in SDR™ group was significantly lower.

Pair-wise comparisons	Mean difference	p-value
Control vs SDR	437.80	<0.001*
Control vs SDR+PEF	305.63	<0.001*
SDR vs SDR+PEF	132.17	<0.001*

[Table/Fig-8]: Pair-wise comparison of fracture resistance (in Newton).
SDR: Smart dentin replacement material; PEF: Polyethylene fibre; SDR+PEF: Smart dentin replacement material along with polyethylene fibre
Post-hoc Tukey test; *indicates a significant difference at p≤0.05

DISCUSSION

The remaining coronal tooth structure significantly impacts the type of restorative material and technique needed to restore endodontically treated teeth [19]. Furthermore, in teeth that have undergone root canal therapy, where structural integrity is already compromised, the presence of expanded marginal discrepancies can heighten fracture susceptibility, especially when subjected to masticatory forces. These interfacial gaps may also undermine restoration durability, frequently requiring subsequent replacement procedures or endodontic retreatment [20]. Dentin weakening occurs through structural loss, obturation forces, irrigant exposure and dehydration, all increasing vertical root fracture vulnerability. Preparing endodontic access cavities causes the cusps of the tooth to bend more, which raises the likelihood of cusps breaking when the tooth is in use [21].

A retrospective study by Chotvorrarak K et al., indicated that molar teeth with structural loss limited to just the occlusal surface can be successfully restored with resin composites alone in the long term [22]. In the present study, teeth restored with SDR™+Fibre showed higher fracture resistance than those with SDR™ alone, though this difference was statistically significant. While SDR™ forms a chemical bond with dental structure, its composition alone provides insufficient reinforcement. The addition of PEF significantly improved fracture resistance, suggesting fibre reinforcement enhances the mechanical properties of these restorations. The study also revealed that the Control group exhibited the highest fracture resistance, consistent with previous research showing that intact teeth possess superior structural integrity [2].

The SDR™ material offers the capability of curing to a depth of approximately 4 mm in a single application, representing roughly twice the curing depth achievable with traditional composite materials [23]. These resins are patent registered as being based on the SDR™ technology (stress-decreasing resin) [24]. SDR™ incorporates a specially modified methacrylate resin containing a polymerisation modulator that decreases the rate of polymerisation, thereby minimising the stresses that typically result from polymerisation shrinkage [25]. This polymerisation modulator can reduce volumetric shrinkage by approximately 20% and polymerisation force by 80%. Finally, it improves mechanical properties [26-29]. However, the significantly lower fracture resistance in the SDR™ group in this study suggests that SDR™ alone may not be sufficient to prevent fractures in endodontically treated teeth, particularly in high-stress areas such as the posterior teeth. This aligns with the study by Magaravalli SR et al., which suggested that SDR™ alone may not provide sufficient reinforcement [10].

Ribbond demonstrates the structural properties as well as handling properties crucial for a fibre-containing composite material. For effective bonding, plasma treatment is done. Ribbond's lightly woven leno weave maintains stability between the warp (length-wise) and weft (cross-wise) fibres while still providing enough openness to allow efficient infusion and wetting of the resins on the fibres, making it easy to handle [15]. It was proposed that the PEF exerted a stress-modifying influence at the interface between the restoration and dentin. An alternative explanation for the findings is that the bonding capacity of the fibre combined with the resin may have bolstered the tooth's fracture strength by keeping both cusps aligned [15].

The performance of the experimental teeth (Group 3) was expected to be enhanced by placing 3 mm strip of Ribbond fibre around their circumference. The concept focused on how the polyethylene network could impact the stress distribution at the restoration-adhesive interface, offering extra reinforcement. Due to PEFs having a higher elastic modulus and lower flexural strength, they might influence the formation of interfacial stresses within the restoration [7,29].

The fracture resistance of experimental Group 3 was nearly equivalent to that of the control group (intact teeth). These new materials and techniques allow clinicians to tackle traditional problems in novel ways, resulting in distinct and creative solutions. Clinicians should rely on their professional judgement and patient preferences when choosing between conventional fillings and crowns for restoring root-filled teeth, as there is currently insufficient evidence to determine which option is definitively superior. The most crucial factor in choosing the type of restoration is the amount of remaining tooth structure, as this can significantly impact both long-term survival and cost [30].

Limitation(s)

One key limitation of the present study is that it was carried out under in-vitro conditions. The findings from this controlled environment may not fully represent outcomes in the complex oral ecosystem. In actual clinical scenarios, teeth experience multidirectional and variable forces that differ substantially from the methodology of applying continuous, increasing pressure. This discrepancy highlights the need for develop advanced testing approaches that more accurately mirror the failure patterns observed in real-world dental settings.

CONCLUSION(S)

The study demonstrates that combining SDR™ with PEF significantly enhances fracture resistance in endodontically treated mandibular molars compared to using SDR™ alone, particularly when there is good remaining tooth structure around the access cavity. This finding suggests that fibre reinforcement provides a viable conservative approach for post-endodontic restoration in posterior teeth, potentially offering an alternative to full-coverage crowns in select clinical scenarios.

REFERENCES

[1] Sule K, Malik A, Kothari A, Rao V. Management of luxation injuries in line with International Association of Dental Traumatology guidelines- two case reports. J Conserv Dent Endod. 2024;27(5):561-63.

[2] Kishen A. Biomechanics of fractures in endodontically treated teeth. Endodontic Topics. 2015;33(1):03-13.

[3] Udoye CI, Sede MA, Jafarzadeh H. The pattern of fracture of endodontically treated teeth. Trauma Monthly. 2014;19(4):e17054.

[4] De Andrade GS, Saavedra GD, Augusto MG, Leon GA, Brandão HC, Tribst JP, et al. Post-endodontic restorative treatments and their mechanical behavior: A narrative review. Dentistry Review. 2023;3(1):100067.

[5] Eliyas S, Jalili J, Martin N. Restoration of the root canal treated tooth. Br Dent J. 2015;218(2):53-62.

[6] Algadhi AA, Mohammed M, Alguman AS, Hommadi AM. Crown or not to Crown after RCT. ResearchGate [Internet]. 2021 Jun 30 [cited 2025 Mar 21];14(2):594. Available from: https://www.researchgate.net/publication/352858571_Crown_or_not_to_Crown_after_RCT#fullTextFileContent.

[7] Hiremath H, Kulkarni S, Hiremath V, Kotipalli M. Evaluation of different fibers and biodentine as alternates to crown coverage for endodontically treated molars: An in-vitro study. J Conserv Dent Endod. 2017;20(2):72-75.

[8] Kaur G, Bansal RK, Bansal M, Bansal D, Garg R, Singla S, et al. Evaluation of marginal adaptation of SDR plus, fiber-reinforced and nanofilled composites in endodontically treated teeth: A scanning electron microscopic study. Cureus. 2024;16(10):e70745.

[9] Kim EH, Jung KH, Son SA, Hur B, Kwon YH, Park JK. Effect of resin thickness on the microhardness and optical properties of bulk-fill resin composites. Restor Dent Endod. 2015;40(2):128-35.

[10] Magaravalli SR, Patel SJ, Rangaswamy P, Ramachandra S, Govindappa K, Hiremath V. Effect of smart dentin replacement, biodentine, and its combination for dentin replacement as alternatives to full-crown coverage for endodontically treated molars: An in vitro study. J Int Soc Prev Community Dent [Internet]. 2019;9(6):559-65. Available from: https://pubmed.ncbi.nlm.nih.gov/32039075/.

[11] Garoushi S, Vallittu P, Shinya A, Lassila L. Influence of increment thickness on light transmission, degree of conversion and micro hardness of bulk fill composites. Odontology. 2016;104(3):291-97.

[12] Choudhury WR, Nekkanti S. Mechanical properties of SDR™ and Biodentine™ as dentin replacement materials: An in vitro study. J Contemp Dent Pract. 2022;23(1):43-48.

[13] Aldegheishem AS, Barakat RM, AlRabiah AM, Binhumaid AH, Eldwakhly E. Fracture resistance of root-canal treated premolars restored with dentin replacement materials: An in-vitro study. Oral Health Prev Dent. 2022;20(1):271-78.

[14] Selvaraj H, Krithikadatta J. Fracture resistance of endodontically treated teeth restored with short fiber reinforced composite and a low viscosity bulk fill composite in class II mesial-occlusal-distal access cavities: An ex-vivo study. Cureus [Internet]. 2023;15(8):e42798. Available from: https://pubmed.ncbi.nlm.nih.gov/37664325/.

[15] Tuloglu N, Bayrak S, Tunc ES. Different clinical applications of bondable reinforcement ribbond in pediatric dentistry. Eur J Dent. 2009;3(4):329-34. PMID: 19826607; PMCID: PMC2761166.

[16] Zotti F, Hu J, Zangani A, Albanese M, Paganelli C. Fracture strength and ribbond fibers: In vitro analysis of mod restorations. J Clin Exp Dent. 2023;15(4):e318-e323.

[17] Hiremath H, Verma D, Khandelwal S, Solanki N, Kulkarni S, Kamra AI. Evaluation of titanium mesh and fibers in reinforcing endodontically treated molars: An in-vitro study. J Conserv Dent. 2022;25(2):189-92.

[18] Shirani F, Saatchi M, Shirani M, Jafari N. Evaluation of the fracture resistance of conservative and ultraconservative access cavity designs with different treatment modalities: An in-vitro study. BioMed Research International [Internet]. 2023 [cited 2024 Feb 22];2023:e7247375. Available from: https://www.hindawi.com/journals/bmri/2023/7247375/.

[19] Jagadish S, Yogesh BG. Fracture resistance of teeth with Class 2 silver amalgam, posterior composite, and glass cermet restorations. Oper Dent. 1990;15(2):42-47.

[20] Arafa MA, Ziada A. Marginal adaptability and fracture resistance of endodontically treated premolars restored with 3D printed and milled endo-crowns. Egyptian Dent J. 2023;69:2137-52.

[21] 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;13:41-51.

[22] Chotvorrarak K, Suksaphar W, Banomyong D. Retrospective study of fracture survival in endodontically treated molars: The effect of single-unit crowns versus direct-resin composite restorations. Restor Dent Endod. 2021;46(2):e20.

[23] Rayyan MM. Comprehensive techniques for intra-radicular rehabilitation of weakened anterior teeth. Egypt Dent J. 2014;60:1289-97.

[24] Sajjan GS, Sahu KK, Varma KM, Sigadam A, Chennanjali K. A comparative evaluation of pushout bond strength of comprehensive techniques for intracanal rehabilitation of structurally compromised roots: An in vitro study. J Oper Dent Endod. 2020;5(1):01-05.

[25] Van Ende A, De Munck J, Van Landuyt KL, Poitevin A, Peumans M, Van Meerbeek B. Bulk-filling of high C-factor posterior cavities: Effect on adhesion to cavity-bottom dentin. Dent Mater. 2013;29(3):269-77.

[26] Braga S, Oliveira L, Rodrigues RB, Bicalho AA, Novais VR, Armstrong S, et al. The effects of cavity preparation and composite resin on bond strength and stress distribution using the microtensile bond test. Oper Dent. 2018;43:81-89.

[27] Chandrasekhar V, Rudrapati L, Badami V, Tummala M. Incremental techniques in direct composite restoration. J Conserv Dent. 2017;20:386.

[28] Alrahlah A. Diametral tensile strength, flexural strength, and surface microhardness of bioactive bulk fill restorative. J Contemp Dent Pract. 2018;19:13-19.
[29] Rudo DN, Karbhari VM. Physical behaviors of fiber reinforcement as applied to tooth stabilization. Dent Clin North Am. 1999;43:7-35, v.
[30] Fedorowicz Z, Carter B, de Souza RF, Chaves CA, Nasser M, Sequeira Byron P. Single crowns versus conventional fillings for the restoration of root filled teeth. Cochrane Database Syst Rev. 2012;16:CD009109.

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