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CONSERVATIVE ENDODONTICS. PRESENT CONCEPTS AND FUTURE PROPOSITIONS OF MINIMALLY INVASIVE ENDODONTIC TREATMENT: A SYSTEMATIC REVIEW

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Abstract

Residual tissue extent and restoration level significantly influence the survival rate of teeth that have undergone endodontic treatment. The aim of the operator is always conservation of maximum tooth structure. This study aimed to review and assess the utilization of a minimally invasive method throughout all phases of root canal therapy, from initiation to completion. We conducted a comprehensive search in PubMed, Web of Science, and Scopus electronic databases to critically evaluate scientific research on the application of minimally invasive principles in the field of endodontics. The search encompassed the period from 2000 to 2023. Two experts in endodontics conducted the initial electronic search, which yielded a total of 634 publications. We assessed the relevance of the recovered texts' summaries by aligning them with the topic of interest. We excluded any summaries deemed irrelevant. We cannot assert with certainty that minimally invasive treatments should be universally used based on the comprehensive analysis of existing material. Nevertheless, by employing meticulous case selection, minimally invasive treatment has the potential to yield a favorable prognosis while preserving the integrity of the dental structure.

Keywords- endodontics, minimal exposure, preserving dentin

Introduction

Minimally invasive endodontics refers to a specialized approach in dentistry that aims to preserve as much of the natural tooth structure as possible while treating the root canal system. This technique involves utilizing advanced technology and techniques to access and clean the infected or damaged area with minimal disruption to the surrounding tissues. By adopting this approach, patients can benefit from reduced post-operative discomfort and a faster healing period. In comparison to traditional endodontic procedures, modern endodontics utilize advanced technology and techniques that can greatly improve the success rates of root canal treatment. Traditional procedures often require multiple visits and involve more invasive techniques, leading to a longer recovery period and increased discomfort for patients. However, modern endodontics allows for completing procedures in a single visit, minimizing disruption to patients' daily lives and enabling a faster, more efficient treatment process. Additionally, the use of digital imaging and 3D scanning

technology in modern endodontics enables more accurate diagnosis and treatment planning, resulting in better outcomes for patients. Minimally invasive procedures are gaining popularity in the dental and endodontic communities. Any tooth that undergoes endodontic treatment has its survival rate significantly impacted by the quantity of residual tissue and the restoration of treated teeth. The concept and goal of minimally invasive endodontics [MIE] is to protect as much of the natural tooth as possible during root canal therapy. Endodontic treatments are effective if they successfully remove all organic materials from the root canal and fill the intricate root canal system (Mukherjee et al.,2017). In the context of modern endodontics, a tooth with a well-shaped canal is necessary for ensuring the long-term health of the tooth's supporting structure. To get the desired results from endodontic therapy, the dentist must strike a balance between preserving the natural tooth structure and removing decay. The present success predictability of endodontics rests on the four pillars of access cavity preparation, root canal shape, cleaning, and restoration. Minimally invasive endodontics [MIE] requires dental surgeons to acquire new skills and dexterity to adapt to a constrained working environment when treating endodontically involved teeth (jaydip et al., 2022). Dental surgeons accomplish this by removing as little dentin as possible during each step of the root canal procedure. Modern equipment, irrigants for cleaning and shaping the canal system, and the use of newer materials have improved the restoration of structure and preservation of natural dentition, and this concept needs to be promoted (Dioguardi et al.,2018). To comprehend the intricate root canal system, dentists use enhanced magnification and illumination for seeing the pulpal area, cutting-edge imaging modalities, and computer software (Abdelhafeez et al., 2023).

Materials and Method

Study design

Study followed PRISMA guidelines for systematic review and aimed to assess the efficacy of a minimally invasive technique throughout all stages of root canal therapy, spanning from initiation to completion. In order to achieve the intended objective, an analysis was conducted of experimental investigations pertaining to the subject matter as documented in the existing literature. Three distinct databases, Pubmed, Web of Science, and Scopus, were chosen in order to conduct a comprehensive search.

Study design

In this review,the research question was formulated as follows: "Does the use of minimally invasive approaches provide greater preventive benefits compared to the traditional method for dental hard tissues in endodontically treated teeth?" We employed the PICO technique to formulate the structured review question, incorporating the elements of population, intervention, comparison, and outcome.

P- Teeth that have undergone endodontic treatment.

I- Minimally invasive techniques employed in the treatment of dental cavities and root canal preparations.

C- Traditional root canal treatment

O- The preservation of the structure of dental hard tissues.

Results

A total of 634 publications were initially retrieved in this investigation (Figure 1). A screening process was used to determine the relevance of article titles to the issue of interest, and only those deemed pertinent were selected for inclusion. After removing 312 duplicate articles and excluding irrelevant ones, the researchers included a total of 107 papers based on an assessment of their summaries. An additional screening procedure was subsequently implemented, which excluded 64 out of the initial 107 articles based on keyword analysis. As a result, the reviewers deemed 7 articles suitable for inclusion in the review. Supplementary deliberations with a third reviewer resolved divergences among the evaluators regarding the correlation between an article and a particular keyword. The study exclusively incorporated original publications while excluding case reports, reviews, and editorials.

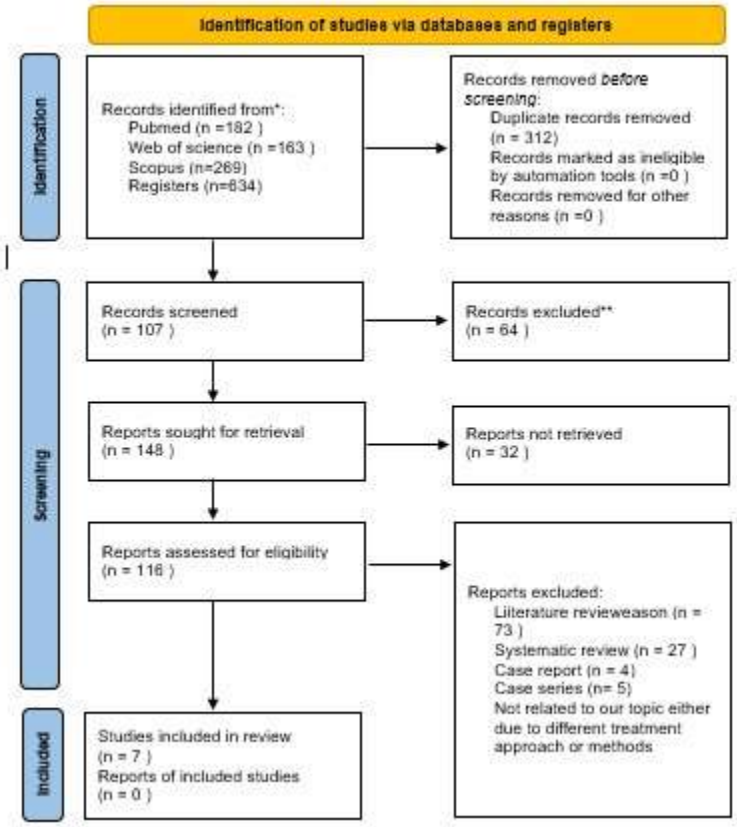

Figure 1. PRISMA Flow diagram

Discussion

After the procedure is complete, the tooth's ability to function normally and retain its original shape and size directly determines the success of a restorative procedure, particularly in endodontics. In their study, Reeh et al. (1989) found that any restorative material used in our restorative methods degrades dentin unequally, when comparing the rigidity of cusps in conventional cavity preparations and endodontic access holes on bicuspid teeth. Unlike any restorative preparation that eliminates the tooth's marginal ridges, which reduces cuspal stiffness by 63%, for example, a MOD preparation, endodontic access holes alone have a relatively minimal influence on tooth stiffness (5%). According to the results, there is a loss of about 20% of tooth strength for every prepared surface (Reeh et al 1989). According to the aforementioned studies, marginal ridges have a significant role in keeping teeth hard.

In clinical practice, it is often believed that teeth that have had endodontic treatment are more fragile as a result. Several new studies on human teeth, on the other hand, show that the dentin properties of endodontically treated teeth are not significantly different from those of vital dentin. This means that the main reason endodontically treated teeth are more likely to break is not structural loss, but rather a decrease in the amount of tooth structure. Recent research has indicated that fractures can arise from a variety of factors, and structural loss is not the sole cause (Sedgley et al., 1992;Bhuva et al., 2021; Kimbley et al., 2023). These studies collectively show that pulpal removal minimally dehydrates and that vital dentin behaves biomechanically similarly to dentin observed in strength and durability tests. Seniors,aged above 55 years exhibit a tensile and fatigue strength of coronal dentin that is as little as fifty percent weaker than that of youthful adults. This difference in strength can result in dentinal fatigue-induced cracks (Arola et al., 2017). Chemical factors such as irrigants and medications, the bacterial effect on the dentin matrix, structural loss due to the effect of post and core restorations, and age changes in dentin can cause dentinal fatigue. Dentin's resistance to fatigue crack propagation decreases with patient age, and the rate of crack extension can be up to one hundred times faster in elderly patients (Bajaj et al., 2006). Dentin highlights its significance by providing natural support for enamel, which is essentially a crystalline structure. Dentin, on the other hand, is a composite material with many levels that functions best as a semi-rigid pipe on its own. Endodontically treated teeth fail under function primarily due to the degree of stress the tooth sustains under load and the underlying biomechanical features of the residual structure responsible for resisting fracture. Root canal (coronal and apical) access is essential. Tooth fracture and the biomechanical behavior of repaired dentin are complicated topics, and there aren't many long-term, controlled clinical trials that can help us understand the link between restoration and post. Long-term clinical outcomes are still the best way to prove something because how people chew creates an infinite number of factors that can affect them. There is evidence that suggests natural teeth, as well as teeth that have had endodontic treatment, might shatter when subjected to forces. According to Kakka et al., (2022) even after endodontic therapy, all teeth, but especially molars, are at risk for breakage. Fractures negatively impact both the periodontal attachment and the neighboring bone (Kakka et al., 2022). Once a root

fracture starts, germs, food particles, cements, and dead tissue start to build up in the reactive periodontium. This causes inflammation. Root fractures appear to be more common in elderly and male populations; previous attrition is often a component of the disease, as shown by Khasnis et al. (2012).

ROOT CANAL CONTOURING

Typically, root canals appear as smooth, hollow tubes with a slight taper. It is a complicated anatomical system because the canals are not round or symmetrical in cross section; they branch, dilacerate, and split; and the canal walls have concavities and convexities. Biomechanical instrumentation aims to create root canal geometries that resist the internal compressive pressures of obturation, hold in place softened and compressed filler materials, and remain strong enough for mastication. The time for dramatic canal-flaring stunts is past. A biomimetic and very conservative endodontic design is needed because the tooth will be stronger and there isn't enough evidence to suggest that bigger shapes lead to fewer endodontic failures and a better seal (Tabassum et al., 2016). Gluskin et al., (2014) introduced the term "working width" to emphasize the importance of comprehending the clinical implications of the horizontal dimension of apical size during root canal cleansing at the apical endpoint (Gluskin et al., 2014). This divides the professional community into two camps, with each side advocating for its own method for cleaning these apical diameters and, by extension, reshaping the root. There are now two overarching tendencies in modern endodontic practice among dentists. Better apical instrumentation and bigger apical diameters with little taper in the canal shape weaken the root structure by taking away the apical dentin and making it harder to control the obturation process. This has led to the recommendation of a preparation with a continuous taper and a smaller apex. Resistant form and a tight apical seal bolster a conservative strategy for generating sufficient shape for effective disinfection.

Considerations in Minimally invasive endodontics

The microbiological etiology of endodontic disease constitutes a critical component of the treatment approach as a whole. Implementing a noninvasive technique for disinfection presents considerable challenges. However, there is no clear response to the question of what size preparation is necessary for antibacterial activity based on in vitro microbiological research. It seems that contemporary cleansing and shaping technologies are incapable of completely eliminating bioburden from the root canal system (Tomson et al., 2016). Consequently, scientists are investigating novel approaches to enhance irrigation efficiency. Sonic, ultrasonic, or other activation up to and including laser activation are all possible physical techniques that provide increased disinfection (Liu et al., 2022). This was demonstrated in vitro by Krishan et al., (2014), utilizing a combined microcomputed tomography and load-to-failure methodology. Twenty-seven researchers discovered that the shape of premolars was not affected by the design of minimum access cavities and that the load to failure for teeth was substantially greater (Krishan et al., 2014).

As all current MIE access preparation models are in vitro, there is a need for clinical trials to determine the relevance of these preparations. Recent studies have shown that different rotational shaping processes used to prepare the canal can cause microcracks in removed teeth. However, it remains unclear if these fractures are also induced in vivo (Haupt et al., 2023). Instruments that decrease vibration and rotational strains during intracanal treatments may be warranted in order to alleviate extra pressure on a structurally compromised root. Hard tissue debris compacted into some canals may render them inaccessible to irrigation, as revealed by Micro-CT research (Brito et al., 2017). However, there is a lack of credible assessments of MIE because it is a relatively new concept. In order to find a happy medium between iatrogenic harm and increased disinfection capability, future root canal preparation methods will likely need to prioritize debridement (Tashkandi et al., 2022). Successful endodontic treatment is contingent upon the implementation of a meticulously executed restoration. Preserving intact coronal and radicular tooth structure, particularly the pericervical structure, allows for a substantial "ferrule effect" and ensures optimal protection while minimizing intrusion (Slutzky et al., 2009). Literature reviews on endodontically treated tooth restoration say that to get the best biomechanical behavior from restored teeth, it is important to keep the coronal and radicular tooth structure intact, especially the pericervical structure, which allows for a large ferrule effect (Garg. 2010; Fuks et al.,2023). According to literature reviews on endodontically treated tooth restoration, endodontically treated teeth with ferrule thicknesses between 1.5 and 2 mm experience reduced fracture (Wolters et al., 2017). Even in clinical scenarios where a circumferential ferrule is not feasible, the utilization of an incomplete ferrule is still regarded as preferable to the absence of any ferrule. In comparison to teeth restored without a ferrule, those reinforced with a ferrule encompassing one millimeter of vertical tooth structure exhibited a twofold increase in resistance to fracture. The study found that a properly fitting ferrule is essential to the long-term health of a tooth that has undergone endodontic treatment (Morgano et al., 2004). Orthodontic extrusion, rather than surgical crown lengthening, should be considered for severely injured teeth with little or no coronal structure in order to give space for a ferrule. This method preserves more of the natural tooth and improves the biomechanical behavior of the remaining dentin structures (Zapata et al., 2002). During the completion appointment, the dentist will finalize the cavosurface outline extension, taking into account the current restoration and restoration strategy. The cavo surface should be appropriately beveled. If bondability is poor or a bond cannot be formed between the substrate and restorative material, aim for a butt joint or 70°–90° interface at the cavosurface. The cavosurface angle should be kept between 70 and 90 degrees in situations requiring numerous visits and a non-bonded interim repair. Rare usage of posts in endodontically treated teeth aligns with the principles of minimally invasive treatment. Post-usage has been deemphasized during the past decade since it results in the wasteful extraction of root dentine (Skupien et al., 2016). Keeping as much of the natural tooth as possible is preferable to using a post, as shown by the data (Mahdi et al., 2022). In order for endodontic therapy to be considered successful in the long run, appropriate restorative care must follow. After restoration, it is important to preserve the integrity of both the tooth's structure and the root canal system. Nowadays, dentists commonly use adhesive materials to repair

the majority of endodontically treated teeth. In common parlance, posts are not considered to "reinforce" the root. While this was generally accepted to be the case with metal posts in early restoration procedures, there is now mounting evidence that bonded fiber posts, which do not require any preparatory work on the dentin, may offer greater root protection and fracture resistance. The core is now supported by supports made of fiber-reinforced resin, which is more elastic. The root fracture risk decreased because less stress was transmitted to the dental structure. Although it may be premature to label adhesive technology as "reinforcing" or "root strengthening," it can certainly be considered "progressive" in terms of distributing forces throughout the remaining dentin structure. Furthermore, posts made of materials with a modulus of elasticity similar to dentin were considered more resilient, able to absorb similar impact forces and distribute the forces of mastication in a more protective manner to remaining dentin than stiffer metallic posts (Haralur et al., 2016). These complications arise from an overly aggressive treatment strategy that does not address the root causes of apical periodontitis and are therefore clinically preventable.

Challenges, Limitations, and Future Perspectives of Minimally Invasive Endodontics

When discussing potential difficulties in certain complex cases, it is important to acknowledge that not all root canal treatments can be performed using minimally invasive techniques. In cases where there is severe calcification or anatomical variation, accessing and cleaning the root canal system can become more challenging. Additionally, the presence of curved or narrow canals may require additional expertise and specialized instruments to ensure proper cleaning and shaping. The use of a microscope for enhanced visualization and precision during root canal procedures is a key aspect of minimally invasive endodontics. The microscope allows the practitioner to see small details and access hard-to-reach areas with greater accuracy, reducing the need for exploratory surgery or additional treatments. In minimally invasive endodontics, ultrasonic instruments and nickel-titanium files are also used to remove infected tissue and debris in a more conservative way, which helps keep more of the natural tooth structure. This results in a higher success rate and a faster healing process for patients. However, a detailed counterexample to the benefits of endodontics could be a case where the dentist's reliance on the microscope causes them to overlook an important detail or miss a hidden infection, leading to further complications and the need for additional treatments. Additionally, in some cases, the use of ultrasonic instruments and nickel-titanium files may inadvertently cause damage to surrounding healthy tissue, potentially resulting in a longer healing process for patients. The introduction of rotary instruments for efficient and precise cleaning and shaping of root canals has been a significant advancement in endodontic treatment. However, there have been instances where the improper use of these instruments has resulted in perforations or fractures of the tooth structure, requiring immediate repairs and potentially compromising the overall success of the procedure. Therefore, while the introduction of rotary instruments has revolutionized endodontics, proper training and expertise are crucial to minimize the risks associated with their use. The application of ultrasonics for better access and removal of debris has also been a significant advancement in endodontic treatment.

Ultrasonic instruments can effectively remove calcified or obstructive materials from the root canal system, improving the success rate of the procedure. However, it is essential for endodontists to have proper training and knowledge of the appropriate techniques and settings to avoid any potential damage to the surrounding tissues. With the right expertise and caution, the use of ultrasonics can greatly enhance the outcomes of endodontic treatments.

Conclusion

In recent times, there has been a significant uptake of minimally invasive therapies within the field of endodontics. Typically, this form of treatment aims to mitigate the loss of hard tissue. The review conducted does not definitively recommend the application of minimally invasive techniques in all cases. Nevertheless, by employing meticulous case selection, minimally invasive treatment has the potential to yield a favorable prognosis while preserving the integrity of the dental structure.

References

1) Mukherjee, P., Patel, A., Chandak, M. and Kashikar, R., 2017. Minimally invasive endodontics a promising future concept: a review article. *International journal of scientific study*, *5*(1), pp.245-251.

2) Marvaniya, J., Agarwal, K., Mehta, D.N., Parmar, N., Shyamal, R., Patel, J. and Mehta, D., 2022. Minimal Invasive Endodontics: A Comprehensive Narrative Review. *Cureus*, *14*(6).

3) Dioguardi, M., Di Gioia, G., Illuzzi, G., Laneve, E., Cocco, A. and Troiano, G., 2018. Endodontic irrigants: Different methods to improve efficacy and related problems. *European journal of dentistry*, *12*(03), pp.459-466.

4) Abdelhafeez, M.M., Alharbi, F.M., Srivastava, S., Eldwakhly, E., Saadaldin, S.A. and Soliman, M., 2023. Perception of Minimum Interventional Dentistry among Dental Undergraduate Students and Interns. *Medicina*, *59*(4), p.649.

5) Reeh, E.S., Messer, H.H. and Douglas, W.H., 1989. Reduction in tooth stiffness as a result of endodontic and restorative procedures. *Journal of endodontics*, *15*(11), pp.512-516.

6) Sedgley, C.M. and Messer, H.H., 1992. Are endodontically treated teeth more brittle?. *Journal of endodontics*, *18*(7), pp.332-335.

7) Bhuva, B., Giovarruscio, M., Rahim, N., Bitter, K. and Mannocci, F., 2021. The restoration of root filled teeth: a review of the clinical literature. *International Endodontic Journal*, *54*(4), pp.509-535.

8) Kimble, P., Stuhr, S., McDonald, N., Venugopalan, A., Campos, M.S. and Cavalcanti, B., 2023. Decision Making in the Restoration of Endodontically Treated Teeth: Effect of Biomimetic Dentistry Training. *Dentistry Journal*, *11*(7), p.159.

9) Arola, D.D., Gao, S., Zhang, H. and Masri, R., 2017. The tooth: its structure and properties. *Dental Clinics*, *61*(4), pp.651-668.

10) Bajaj, D., Sundaram, N., Nazari, A. and Arola, D., 2006. Age, dehydration and fatigue crack growth in dentin. *Biomaterials*, *27*(11), pp.2507-2517.

11) Kakka, A., Gavriil, D. and Whitworth, J., 2022. Treatment of cracked teeth: A comprehensive narrative review. *Clinical and Experimental Dental Research*, *8*(5), pp.1218-1248.

12) Khasnis, S.A., Kidiyoor, K.H., Patil, A.B. and Kenganal, S.B., 2014. Vertical root fractures and their management. *Journal of conservative dentistry: JCD*, *17*(2), p.103.

13) Tabassum, S. and Khan, F.R., 2016. Failure of endodontic treatment: The usual suspects. *European journal of dentistry*, *10*(01), pp.144-147.

14) Gluskin, A.H., Peters, C.I. and Peters, O.A., 2014. Minimally invasive endodontics: challenging prevailing paradigms. *British dental journal*, *216*(6), pp.347-353.

15) Tomson PL, Simon SR. Contemporary cleaning and shaping of the root canal system. Primary dental journal. 2016 May;5(2):46-53. 10.1308/205016816819304196

16) Liu, C., Li, Q., Yue, L. and Zou, X., 2022. Evaluation of sonic, ultrasonic, and laser irrigation activation systems to eliminate bacteria from the dentinal tubules of the root canal system. *Journal of Applied Oral Science*, *30*.

17) Krishan, R., Paqué, F., Ossareh, A., Kishen, A., Dao, T. and Friedman, S., 2014. Impacts of conservative endodontic cavity on root canal instrumentation efficacy and resistance to fracture assessed in incisors, premolars, and molars. *Journal of endodontics*, *40*(8), pp.1160-1166.

18) Haupt, F., Dullin, C., Krebs, M., Hettwer-Steeger, I., Kanzow, P. and Rödig, T., 2023. Micro-CT evaluation of frozen and embalmed human cadavers on the effect of root canal preparation on microcrack formation in old dentin. *Plos one*, *18*(1), p.e0281124.

19) Brito, A.C.R., Verner, F.S., Junqueira, R.B., Yamasaki, M.C., Queiroz, P.M., Freitas, D.Q. and Oliveira-Santos, C., 2017. Detection of fractured endodontic instruments in root canals: comparison between different digital radiography systems and cone-beam computed tomography. *Journal of endodontics*, *43*(4), pp.544-549.

20) Tashkandi, N. and Alghamdi, F., 2022. Effect of chemical debridement and irrigant activation on endodontic treatment outcomes: an updated overview. *Cureus*, *14*(1).

21) Slutzky-Goldberg, I., Slutzky, H., Gorfil, C. and Smidt, A., 2009. Restoration of endodontically treated teeth review and treatment recommendations. *International journal of dentistry*, *2009*.

22) Garg, N. and Garg, A., 2010. *Textbook of endodontics*. Boydell & Brewer Ltd.

23) Fuks, A.B., Moskovitz, M. and Tickotsky, N. eds., 2023. *Contemporary Endodontics for Children and Adolescents*. Springer Nature.

24) Wolters, W.J., Duncan, H.F., Tomson, P.L., Karim, I.E., McKenna, G., Dorri, M., Stangvaltaite, L. and Van Der Sluis, L.W.M., 2017. Minimally invasive endodontics: a new diagnostic system for assessing pulpitis and subsequent treatment needs. *Int Endod J*, *50*(9), pp.825-9.

25) Vikhe, D.M., 2021. Restoration of Endodontically Treated Teeth. In *Clinical Concepts and Practical Management Techniques in Dentistry*. IntechOpen.

26) Ordinola-Zapata, R., Lin, F., Nagarkar, S. and Perdigão, J., 2022. A critical analysis of research methods and experimental models to study the load capacity and clinical behaviour of the root filled teeth. *International Endodontic Journal*, *55*, pp.471-494.

27) Skupien, J.A., Luz, M.S. and Pereira-Cenci, T., 2016. Ferrule effect: a meta-analysis. *JDR Clinical & Translational Research*, *1*(1), pp.31-39.

28) Mahdi, S., Hamasaeed, N., Khudhur, H. and Tawfiq, H., 2022. Preference for Using Posts to Restore Endodontically Treated Teeth among Dentists in College of Dentistry/Hawler Medical University. *Sulaimani Dental Journal*, *9*(1), pp.9-9.

29) Haralur, S.B., Al-Qahtani, A.S., Al-Qarni, M.M., Al-Homrany, R.M. and Aboalkhair, A.E., 2016. Influence of remaining dentin wall thickness on the fracture strength of endodontically treated tooth. *Journal of conservative dentistry: JCD*, *19*(1), p.63.