



TREATING STRESSED PULP CONDITIONS WITH AN ENDODONTIC-RESTORATIVE DIAGNOSIS: A SYSTEMATIC REVIEW

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Abstract:

Aim: This systematic review aimed to assess the effectiveness of endodontic-restorative diagnoses in treating stressed pulp conditions and evaluate the impact of comprehensive pulp assessments on treatment outcomes.

Materials and Methods: A detailed literature search was performed across multiple databases, including PubMed, the Cochrane Library, EBSCOhost, and EMBASE, to identify relevant studies addressing endodontic-restorative management of stressed pulp conditions. Ten primary studies were selected based on predefined criteria, including diagnostic approaches, treatment methodologies, and reported outcomes. Data from ten studies meeting the inclusion criteria were analyzed to determine the effectiveness of thorough pulp assessments.

Results: This review revealed that comprehensive assessments of stressed pulp conditions, including detailed patient history and diagnostic testing, significantly enhanced diagnostic accuracy and treatment effectiveness. The identification of stressed pulp states is crucial for an accurate diagnosis and successful endodontic-restorative interventions. Studies have consistently shown improved outcomes when thorough evaluations are conducted before treatment.

Conclusion: Incorporating detailed pulp assessments into routine clinical practice is essential for improving the efficacy of endodontic-restorative treatments. In this context, the review highlighted the need for standardized diagnostic criteria and more rigorous study designs in future research to validate these findings and advance clinical practice.

Keywords: stressed pulp; endodontic-restorative diagnosis; diagnostic accuracy; pulp assessment; interventions



Introduction

The dental pulp is a special anatomical and physiological constituent of teeth that is capable of overcoming initial damage. Nevertheless, such recovery depends on a variety of elements that may have crippling and long-lasting consequences and lessen the pulp's capacity for healing. If the pulp is subjected to more trauma, it may or may not heal [1]. For a restorative dentist, assessing the pulpal condition is of the greatest priority. Following dental restorations, pulpal difficulties can be caused by (i) additional surgical trauma, (ii) worsening of undiscovered pulpal illness, or (iii) the transition of healthy pulp into a diseased state. The conventional wisdom about pulpal life and pulp-testing techniques is naive, careless, and full of misconceptions [2]. The majority of thorough pulpal diagnoses are seldomly made or only rendered when symptoms appear. At most, this diagnosis is predicated on monitoring how a patient responds to thermal or electrical pulpal tests. These approaches are ineffective, as evidenced by the intricacy and variety of human responses to injury and disease, as well as the inconsistency of pain as a marker of tissue damage [3]. The method by which the dental pulp reacts to a stimulus may be unrelated to its actual histologic state. Acute pulpal vitality is difficult to precisely quantify and typically is deduced from test findings [4]. Pulp reactions to stimuli depend on a variety of factors, including patient sensitivity to unpleasant stimuli, tooth form, age, and systemic health [5].

In 1982, Abou-Rass first introduced the term “stressed pulp”, highlighting the importance of considering the pulp as stressed under recurring pathological conditions [2]. According to Abou-Rass [2], surgical trauma, mishaps, or other pathological alterations can all cause chronic injury to the dental pulp, which is why it is referred to as “stressed pulp”. The stressed pulp state is not a histological entity but rather a clinical notion [6]. Before any substantial restorative dentistry or even other dental operations are performed, the stressed pulp state should be considered. Even though a stressed pulp is typically asymptomatic clinically, it can quickly degenerate into a pathogenic or necrotic condition. The pulp can go from being in a situation of asymptomatic pressure to being in a state of pulpal illness as a result of crown procedures, pin residues, restorative errors, dental fissures, and poor systemic factors.

The main factor causing prolonged inflamed root resorption and the failure of granulation tissue to cure horizontal root fracture in damaged teeth is pulpal infectious disease. Thus, the removal of pulp infection should be able to cause soft tissue, hard tissue, or a composite of soft and hard tissue to repair root disintegration and horizontal root fractures. For damaged teeth with horizontal root fracture and inflamed root resorption, the fundamental goals of standard and restorative endodontic therapy are the same: elimination of symptoms and resolution of the lesion caused by infection [7]. In contrast to standard root canal therapy, which aims to cover the canal area with biocompatible foreign substances to avoid reinfection, regenerative endodontic therapy focuses on restoring the vitality, immunology, and hypersensitivity of tissues in the canal space. The only tissue that can regenerate, heal, and create an immune-inflammatory defense reaction is vital [7].

Rationale for the Study

The rationale behind the current systematic review is essential to comprehensively evaluate and synthesize the impact of endodontic and restorative interactions on stressed pulp conditions. Despite advancements in dental technology and techniques, the diagnosis and management of stressed pulp remain challenging due to its asymptomatic nature and complex response to stimuli. By systematically reviewing existing research studies, this study aims to identify patterns and assess the effectiveness of various treatment approaches when used simultaneously with stress pulp diagnostic and assessment methods compared with those used without such assessment. The common endodontic treatment is root canal therapy and common restorative procedures, such as dental crowns, fillings, and veneers. In addition, this review is necessary to

clarify the factors influencing pulpal health. This approach will provide a consolidated understanding of how different interventions affect stressed pulp, ultimately guiding more effective clinical practices and improving patient outcomes [8].

Aim of the Review

This study aims to elaborate on stressed pulp conditions and how endodontic-restorative interactions influence the outcome of pulp.

Materials and Methods

The present review was reported according to the NEW Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 Checklist [9]. The systematic review methodology involves aggregating and analyzing existing primary research to draw well-supported conclusions on a specific issue. Unlike general literature reviews, systematic reviews offer a more structured approach to addressing clinical research questions by systematically assessing and integrating findings from various studies [10,11]. This methodology was selected for this research to provide a thorough evaluation of how endodontic-restorative interactions affect stressed pulp conditions. By systematically reviewing the evidence, this approach aims to produce reliable insights for evidence-based practice and policy development [12]. Relying on individual studies alone could result in biased outcomes, highlighting the need for a comprehensive review to ensure a balanced and accurate understanding [8]. A step-by-step process is selected for this systematic review study, as specified below.

Clinical Review Question

The clinical research question for the current study, which uses a mixed-methods strategy to collect both qualitative and quantitative data from primary research articles on the topic of treating stressed pulp conditions with an endodontic-restorative diagnosis, is formulated using the Population, Intervention, Comparator, and Outcome (PICO) framework [12]. The PICO framework is commonly used in quantitative systematic reviews, whereas the Population, Exposure, and Outcome (PEO) framework is recommended for qualitative reviews in nursing research. The reason PICO was chosen over PEO is because of its ability to collect both patient perspectives and quantitative data through its four components, namely, population, intervention, comparator, and outcomes. In contrast, the PEO framework would have data collection limited to numerical results alone [8]. For this purpose, the current review question developed for the current systematic review is as follows: population = patients with stressed pulp conditions; intervention = interaction between endodontic-restorative diagnosis; comparator = treatment effects after stressed pulp assessment vs. treatment effects without stressed pulp assessment; and outcomes = treatment effects.

- How effective is treating stressed pulp conditions with an endodontic-restorative diagnosis?

Eligibility Criteria

The following eligibility criteria were used to group the studies in this systematic review.

Inclusion Criteria

- Qualitative and quantitative primary studies;
- Studies that were published in English;
- Studies published in the last 22 years from January 2000 to November 2022;
- Studies that investigated the implications of stressed pulp;
- Studies that have examined the role of endodontic–restorative interactions in pulpal health.

Exclusion Criteria

- Studies published in languages other than English were included to avoid language bias.

- Editorials, letters, abstracts, comments, and book chapters do not provide primary research data.
- Studies conducted on animal models are not directly applicable to human dental pulp.
- Studies that did not assess the impact of stressful conditions on dental pulp were included to ensure the relevance of the findings to the research question.

Studies meeting the inclusion criteria were further grouped and analyzed to address the research questions effectively, while those meeting the exclusion criteria were eliminated to minimize potential sources of bias.

Information Sources

An electronic literature search was performed in the MEDLINE (PubMed), Cochrane Library, EBSCOhost (Dentistry & Oral Sciences Source) and Embase databases.

Search Strategy

The review did not involve contacting previous study authors or including gray literature sources because of the focus on primary studies. The screening procedure was conducted step-by-step to ensure a complete and unbiased examination of the literature [11]. The first initial step included screening titles and abstracts to find articles that met the inclusion criteria. Then, full-text publications were evaluated for eligibility. Data were then retrieved from the included studies and reviewed for quality and relevance to verify that the findings were robust and reliable.

In this context, the literature search covered studies published between January 1, 2000, and November 31, 2022. Additionally, references from textbooks and selected articles were reviewed to identify any relevant studies. The search strategy incorporated the following terms with the BOOLEAN operator: (((((stressed) AND (pulp)) AND (endodontics)) AND (restorative)) AND (trauma)) AND (injury).

Data Collection Process

Two independent reviewers collected data for this systematic review by extracting essential information from each report, such as research characteristics, intervention details, and results [13]. The reviewers worked independently to ensure accuracy and eliminate prejudice, with any disagreements handled through discussion. A third reviewer was contacted for an additional opinion when needed. The assessment focused on public data; hence, no direct data confirmation from research investigators was conducted. A consistent data extraction form was utilized to ensure consistency and thoroughness, and no automation technologies were used during the process, allowing for careful verification and validation of the acquired data [10].

Data Items

The data for this systematic review were gathered from each included study and covered a wide range of topics relevant to the research goals. These included study parameters (e.g., authors, publication year, sample size), intervention and comparison details (e.g., kind of endodontic and restorative procedures), stress-related pulp outcomes (e.g., clinical and radiographic results), and any documented side effects [8]. The extraction procedure sought to collect comprehensive data required for a detailed examination of the influence of endodontic-restorative interactions on pulpal health.

Study Risk of Bias Assessment

The risk of bias for each included study was assessed using known methodologies and criteria appropriate for the study design. This review aimed to identify potential causes of bias in study technique, including selection bias, performance bias, detection bias, and reporting bias. Researchers independently assessed each study to ensure that the results and conclusions were accurate and legitimate, and any high-risk studies were identified for their possible impact on the overall review findings [8].

Effect Measures

The effect measures were derived using the outcomes provided in the included studies. Risk ratios, odds ratios, mean differences, and normalized mean differences were often used as effect measures, depending on the nature of the data and the outcomes being analyzed. These metrics quantified the influence of endodontic-restorative interactions on stressed pulp, allowing for cross-study comparisons and generating inferences regarding the efficacy of various therapies [8].

Synthesis Methods

The data from the included research were analyzed using thematic analysis to examine findings from both qualitative and quantitative methodologies [13]. Statistical analysis was used to include quantitative data, including effect sizes if given in respective studies, to estimate total impacts and discover patterns. On the other hand, qualitative data were narratively synthesized to provide context and insights into how endodontic-restorative interactions affect pulpal health. The synthesis was intended to thoroughly incorporate findings while effectively addressing research issues.

Reporting Bias Assessment

Reporting bias was determined by examining the accuracy and transparency of reporting in the included studies. This included looking for selective reporting of results, publishing bias, and discrepancies between reported and actual findings. The potential impact of reporting bias on the review's conclusions was assessed using tools such as funnel plots and statistical tests, ensuring that the results were as accurate and impartial as possible [11].

Certainty Assessment

The reliability of evidence was evaluated using known frameworks such as the Grading of Recommendations, Assessment, Development, and Evaluations (GRADE) system. This evaluation considered variables such as study design, bias risk, inconsistency, indirectness, and evidence imprecision. Each outcome was graded to determine overall confidence in the findings, which guided the degree of recommendations and conclusions based on the systematic review.

Results

Search and Study Selection

The process of retrieving and screening the studies included in this systematic review is shown in Figure 1. After an initial search, a total of 120 articles were identified. After screening the titles and abstracts, only 20 were found to be relevant. The remaining 10 studies were excluded because some of them were duplicates and irrelevant and others did not meet the inclusion criteria. Finally, 10 studies met all the inclusion criteria and were included in the review.

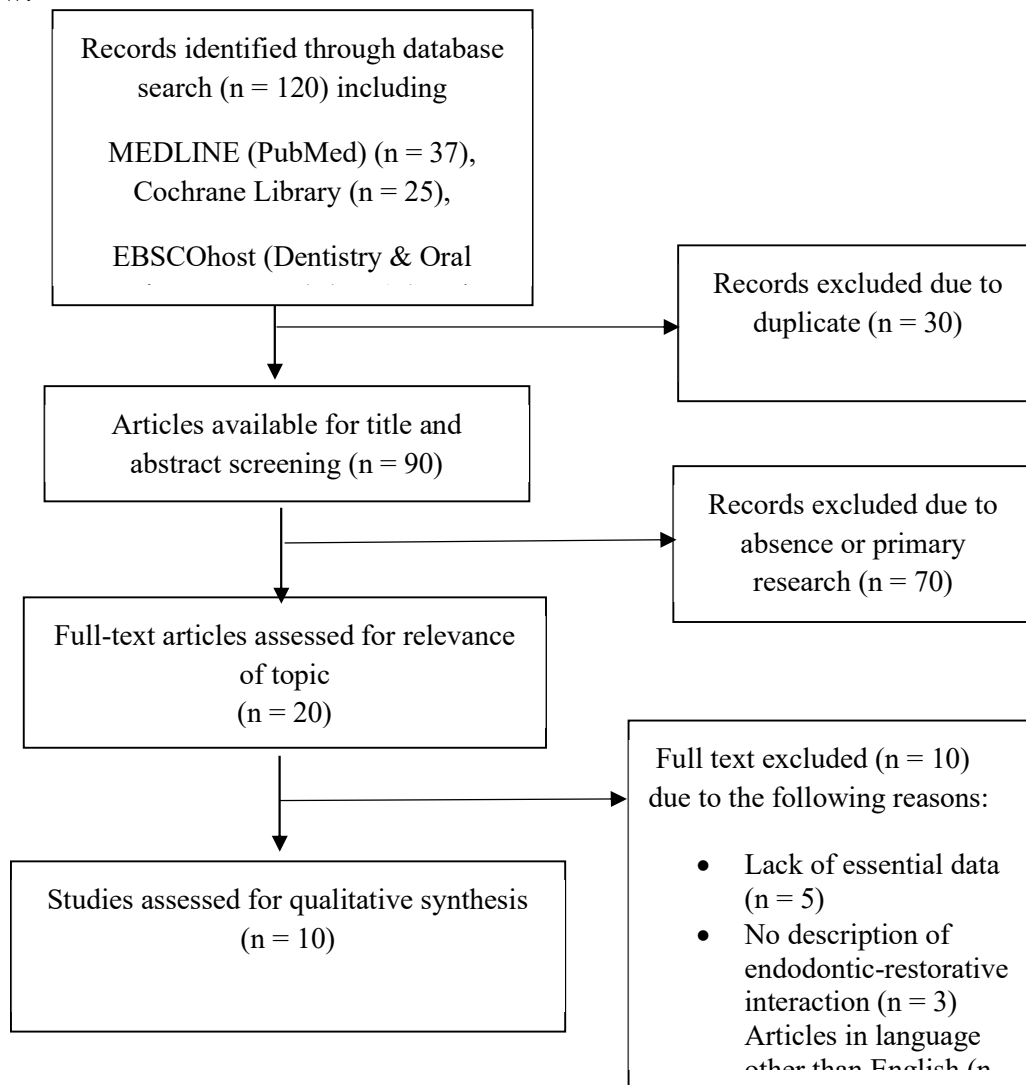


Figure 1. PRISMA diagram for selection process.

5.2. Characteristics of Studies Included in the Review

The included studies assessed several factors related to clinical presentation and treatment approaches, as mentioned in Table 1.

Table 1. Systematic review analysis – summary of primary studies.

Study	Authors	Sample Size	Age Range/ Mean Age	Treatment/Procedure	Outcomes/ Results	Follow-Up Duration	Key Findings
Biodentine Pulpotomies on Permanent Traumatized Teeth with Complicated Crown Fractures	Haikal et al. [14]	45 patients	8–16 years (mean 10.8)	Biodentine pulpotomy	Survival rate: 100%; Success rate: 91%. Four failures, treated with a root canal or regenerative endodontics. 91% had dentinal bridge formation. Slight discoloration in 17% of teeth.	1, 3, 6, 12, 18, 24 months	Biodentine is effective for pulpotomies in anterior teeth with complicated fractures, with high success and survival rates.
Treatment of Deep Caries Lesions in Adults	Bjørndal et al. [15]	314 adults	-	Stepwise excavation vs. direct excavation, direct capping vs.	Stepwise excavation resulted in fewer pulp exposures and a higher success rate	1 year	Stepwise excavation reduces pulp exposure risk; no significant difference between direct capping and

				partial pulpotomy	compared to those using direct excavation. No significant difference between direct capping and partial pulpotomy.		partial pulpotomy for exposed pulps.
Role of Dental Pulp in Age Estimation	Baker et al. [16]	120 extracted teeth	20–80 years	Histopathological analysis of pulp	Significant reduction in odontoblasts, mean vessel area, and diameter with age. Collagen fiber thickness increased with age. Highest accuracy when combining all parameters.	-	Collagen fiber thickness is the most accurate for age estimation, with combined parameters giving the highest accuracy (90.9%).
Incidence of Asymptomatic Pulp Necrosis	Kontakiotis et al. [17]	120 teeth		Electric pulp testing before and after	Incidence of pulp necrosis: 9%. Higher in preoperati	-	Pulp necrosis is more common in preoperatively compromised

Following Crown Preparation				crow preparation	vely compromised teeth (13%). The positive predictive value of electric pulp testing was 1.00.		teeth; electric pulp testing is highly predictive.
Full Pulpotomy with Biodentine in Symptomatic Young Permanent Teeth with Carious Exposure	Taha and Abdu lkhad er [18]	14 patients 20 teeth	9–17 years (mean 12.3)	Biodentine pulpotomy	Clinical success rate: 100% at 6 months and 1 year. Radiographic success: 95% with dentin bridge formation in 25% of teeth.	6 months, 1 year	Biodentine pulpotomy is highly successful for young permanent teeth with carious exposure, with high clinical and radiographic success rates.
Regenerative Endodontic Procedures for Traumatized Teeth	Saoud et al. [7]	3 cases	-	Regenerative endodontic procedures	Clinical signs/symptoms resolved; radiographic healing observed. Healing by calcified tissue and fibrous connective tissue in cases	5 years (for one case)	Regenerative endodontic procedures can effectively treat traumatized teeth with horizontal root fractures and inflammatory resorption.

					with horizontal root fractures.		
Relationship of Patient Complaints and Signs to Histopathologic Diagnoses of Pulpal Condition	Cisneros-Cabello and Segura-Egea [19]	240 cases	-	Histopathological examination of pulp	Significant association between specific symptoms (e.g., pain) and chronic pulpitis. The reliability of symptoms varies.	-	Clinical symptoms such as previous pain and prolonged pain on cold stimuli are significant for diagnosing chronic pulpitis.
Evaluation of Stress Distribution on Endodontically Treated Teeth	Kirmali et al. [20]	5 models		Finite element analysis (FEA)	Maximum stress values varied with different restorative materials. E-max crowns had the highest stress; composite-filled teeth had the lowest. All models showed similar stress	-	Composite resin restorations are recommended for root canal-treated teeth with lesions; zirconia or metal-supported crowns are advantageous for biomechanics.

					distributi ons.		
Endodontic Treatment: An Analysis of Demand by Adult Patients in Southern Nigeria	Agholor and Sede [21]	485 patients	18–68 years	Retrospective review of clinical records	The highest demand for RCT in ages 20–29; irreversible pulpitis was the most common indication. More maxillary teeth were treated; the mandibular first molar was the most frequent tooth.	-	High demand for endodontic treatment among young adults and females, with most procedures on maxillary teeth and mandibular first molar.
Factors Associated with the Need for a Primary Endodontic Treatment After a Single-Unit Crown Cementation	Won and Berlin-Broneer [22]	69 teeth	Not specified	Single-unit crown cementation	- Teeth with ≥ 2 restorations before crown cementation had a 3.81 times higher risk of needing endodontic treatment. - Teeth with ≥ 3	Mean follow-up duration: 3 years	Multiple restorations before crown cementation significantly increase the risk of needing endodontic treatment.

					restorations had 5.97 times higher risk. - 65% of cases required endodontic treatment within the first 3 years.		
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Patient Report on Tooth History

Patient history plays a pivotal role in diagnosing stressed pulp conditions and evaluating the impact of endodontic-restorative interactions. Of the ten studies reviewed, six addressed the role of patient history in diagnosing stressed pulp conditions [17,18,22]. These studies highlighted that patients with stressed pulp conditions often reported no prior discomfort or pain related to the affected tooth. Despite the absence of pain, subtle signs of accumulated pulp damage were evident, linked to factors such as orthodontic treatments, previous trauma, multiple restorations, or overall compromised health [16,19]. The findings related to tooth history confirmed the need for a comprehensive diagnostic approach for stressed pulp assessment to treat effectively with appropriate intervention, as the absence of prior pain does not rule out underlying pulpal issues.

Tooth and Tissue Examination

In the review of the ten studies, four focused on findings from tooth and tissue examinations [7,14,16,20]. These examinations revealed frequent multiple restorations in dental crowns, indicating a history of numerous interventions. Additional findings included signs of erosion, abrasion, or fissures, reflecting stress endured over time. Changes in tooth color due to aging and advanced diagnostic techniques such as transillumination further highlighted concealed cracks or structural irregularities, enhancing diagnostic precision.

Radiographic Evaluation

Three of the ten studies examined the use of radiographic evaluation in assessing stressed pulp conditions [7,16,18]. Radiographic findings in stressed pulps often included pulp space retraction, formation of pulp stones, tissue repair dentin, tiny channels, and remnants of previous restorations or pulp capping procedures. These radiographic features provided essential visual evidence for assessing the internal status of the tooth, thereby guiding diagnostic and treatment decisions.

Tooth Response to Stimuli

Among the 10 studies, two addressed the response of a tooth to various stimuli as a diagnostic criterion [19,21]. The review revealed that stressed pulps often exhibited slow, weak, or delayed responses to electrical stimuli and sometimes no response at all if the stimulation was insufficient. Reactions to thermal stimuli, such as CO₂ ice application, were more effective in eliciting responses. This variability in response highlighted the need for careful consideration of

different stimuli in diagnosing pulp conditions. Additionally, the thickness of the remaining dentin significantly affects the pulp's healing capacity, with less than 0.2 cm of dentin reducing the likelihood of healing [23].

General Factor Considerations

Two of the ten studies addressed general considerations related to pulp health, including physiological age, vascular flow, and systemic health [16]. These factors were critical in determining the healing potential of stressed pulps. Younger, healthier patients typically showed better healing responses. The review also noted that endodontic procedures, particularly root canal therapy, were prevalent in molars and among patients aged 35–44 years, with variations based on tooth type and patient demographics. The review emphasized the complexity of diagnosing and managing pulpal conditions due to the variability in pulp responses and the limitations of traditional diagnostic methods [15].

Discussion

Effectiveness of Treatment with Stressed Pulp Assessment

Incorporating a stressed pulp assessment before treatment has been shown to lead to more accurate diagnoses and improved outcomes [14,15,20,21]. Other systematic reviews, such as those of Krastl et al. [24] and Bourguignon et al. [4], have further emphasized that a comprehensive evaluation, including patient history and radiographic findings, enhances treatment effectiveness. An accurate assessment allows for targeted interventions, minimizing complications associated with untreated or misdiagnosed pulpal issues. This finding was consistent with that of Oglah et al. [5] and Boykin et al. [25], who highlighted that detailed pulp assessments more effectively address symptoms such as pain and abscesses. These findings also align with those of Kawahara and Yamagami [23], who noted that the pulp's capacity to heal depends on factors such as dentin thickness and the physiological state of the tooth. Preserving a minimum dentin thickness of 0.2 cm between the crown preparation or cavity floor and the pulp is crucial for safeguarding pulp vitality [23]. Additionally, the physiological age of the tooth, including the size of the apical foramen and the presence of calcification crystals, significantly impacts the ability of the pulp to heal [16]. This comprehensive understanding supports more effective treatment strategies.

Treatment Effects Without Stressed Pulp Assessment

On the other hand, studies that did not incorporate a stressed pulp assessment often reported suboptimal results [22]. Similar to this review, Bergenholtz et al. [26] reported that the absence of thorough evaluation leads to increased risk of misdiagnosis and inadequate treatment, substantiated by a past research study of Seltzer et al. [27]. These studies mutually agreed that without assessing stressed pulp conditions, conventional diagnostic methods might overlook underlying issues, resulting in complications such as undiagnosed pulp damage or inadequate restoration practices. This is particularly relevant in cases where the pulp cavity has retracted or become encumbered by calcification crystals, leading to diminished healing prospects. As shown by the review, patients who undergo endodontic procedures without prior assessment might encounter complications due to undiagnosed pulp damage or improper restoration techniques.

This review extends and supports earlier research by demonstrating that a comprehensive assessment of stressed pulps before treatment results in better outcomes [20]. First, several factors have been shown to influence the capacity of the pulp to heal from pathologic and surgical stress. While the extent of the injury is crucial, minor injuries are typically expected to heal efficiently, whereas severe injuries with less than 0.2 cm of remaining dentin pose greater risks and reduce healing prospects [23]. The physiological age of the tooth, including the size of the apical foramen and the presence of calcification crystals, significantly impacts healing ability.

Host variables, such as age and overall health, also play a critical role, with younger and healthier individuals generally showing better healing responses. Chronic injuries from dental disorders or surgical trauma can diminish the ability of the pulp to withstand additional stress.

Similarly, endodontic procedures were also discussed as essential for managing dental caries and other issues. Pain and dental abscesses are common reasons for seeking root canal therapy [3]. Maxillary molars and premolars are treated more frequently than mandibular incisors, and endodontic treatment is more common in seniors and children under 12 years of age [5,6]. Sex differences also affect treatment prevalence, with females showing a greater incidence of root canal therapy [28]. In a similar context, diagnosing pulp conditions involves significant challenges due to the subjective nature of pain perception and the variety of potential pain sources. The variability in the pain response and the multifactorial etiologies of pulp conditions complicate accurate diagnosis. Pulp tests, such as electric pulp testing (EPT), offer valuable diagnostic insights by comparing electrical responsiveness over time, although they do not always provide reliable data on pulp status. Radiographic evaluations, despite their limitations in depicting 3D structures, remain a critical component of the diagnostic process [4].

A critical review of studies revealed that periapical (PA) radiographs continue to be the gold standard in initial assessments, despite the limitations of 2D imaging in representing 3D anatomical structures [4,7,18,24]. The concept of stressed pulp, indicating neither healthy nor ill pulps, underscores the importance of comprehensive evaluation. While many stressed pulp conditions do not require immediate treatment, dentists must consider the potential for future symptoms and prioritize endodontic therapy before restorative procedures.

Implications of Stressed Pulp in Restorative Dentistry

Recognizing stressed pulps has shifted treatment planning paradigms since they were introduced by Abou-Rass [2] in 1982. Comprehensive risk assessment and individualized treatment strategies are crucial. Dentists must evaluate dental history, previous traumas, orthodontic interventions, and overall oral health to address potential complications. Proactive endodontic intervention can mitigate the risks associated with restorative procedures, aligning with the principle of preserving pulp vitality. Orthodontic treatments should also consider pulp health to prevent complications from stress-induced pulpitis. Educating patients about the implications of stressed pulp and the potential for future issues empowers them to make informed decisions and engage actively in their oral health care.

Study Strengths

The strength of this review is its extensive analysis of 10 studies, which together provide a strong assessment of treatment outcomes for stressed pulp diseases. This review highlights a comprehensive picture of the effectiveness of endodontic-restorative therapies, including a variety of diagnostic techniques and treatment strategies. The inclusion of diverse studies improved the trustworthiness of the findings by capturing variations in patient demographics, treatment approaches, and diagnostic instruments. In addition, the incorporation of previous research emphasized the growth of diagnostic and treatment procedures and offered significant insights into current best practices and their congruence with historical findings.

Recommendations for Further Studies

To evaluate the long-term efficacy of stressed pulp assessments in diverse clinical contexts, future research should concentrate on longitudinal investigations. Examining the effects of various diagnostic instruments, such as biomarkers and sophisticated imaging methods, may help improve diagnostic precision and therapy plans. Research on the interactions among restorative materials, pulp health, and patient-specific variables (such as age and systemic health) could yield a more profound understanding of how to maximize treatment results [14,16]. Furthermore, investigating the effects of all-encompassing diagnostic methods on patient well-being and

contentment with treatment will be beneficial in comprehending the wider consequences of stressed pulp evaluations.

Risk of Bias Debate

The review acknowledged the possibility of bias inherent in the included studies. Variations in study design, diagnostic criteria, and treatment methods may introduce biases into the findings, affecting their generalizability. For example, some studies might have used outdated diagnostic procedures or limited sample sizes, which are likely to distort the results. However, the strength of this review is its attempt to counteract these biases by incorporating a wide range of studies and rigorously examining their techniques [18,22]. However, future research should aim for more rigorous study designs, such as randomized controlled trials and established diagnostic criteria, to reduce bias and improve the validity of findings. Addressing these difficulties will strengthen the results gained from future studies and offer more credible recommendations for clinical practice.

Conclusion

This systematic review assessed the effectiveness of treating stressed pulp conditions via endodontic-restorative diagnosis. On the basis of evaluations, including patient history, radiographic analysis, and diagnostic tests, incorporating thorough assessments before treatment significantly improved the effectiveness of endodontic-restorative interventions. The term “stressed pulp state” describes pulps that have endured recurrent harm but have survived with diminished responses and repair potential. Effective management of such conditions requires a detailed pulpal health assessment before initiating any restorative procedures. This evaluation should include traditional pulp tests and consider the tooth's previous, ongoing, and anticipated treatments, highlighting the importance of addressing stressed pulps before undertaking complex restorative care.

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