Review article

From blood to biology: evaluating platelet-rich plasma as a scaffold in regenerative endodontics — a systematic review

Resti Allo Padang [1], Yayah Inayah [1*], Fajriani [1], Agnita Syarif [1], Giska Anandita Cahyani [1], Andi Wahyuni [1]

1 Department of Pediatric Dentistry, Faculty of Dentistry, Hasanuddin University, Makassar, Indonesia
*Corresponding author: yayah.inayah@unhas.ac.id

Received date: 10-11-2025
Accepted date: 20-01-2026
Published date: 15-03-2026

Article DOI

Abstract: Background: To compare autologous platelet concentrates (platelet-rich plasma [PRP] and platelet-rich fibrin [PRF]) with conventional induced blood clot (BC) and other scaffold approaches in regenerative endodontic therapy (RET) for necrotic immature permanent teeth. Data: Randomized controlled trials (RCTs) reporting clinical outcomes and/or radiographic measures of continued root development (e.g., root length, dentinal wall thickness, apical closure, periapical healing) after RET. Sources: A systematic search of PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar was conducted for studies published from February 2015 to February 2025. Reference lists of included studies were hand-searched. The review followed PRISMA 2020 reporting guidance. Study selection: Eligible studies were human RCTs evaluating PRP and/or PRF as a scaffold for RET in necrotic immature permanent teeth, with a comparator scaffold (BC or another platelet-derived scaffold). Two reviewers independently screened and selected studies. Six RCTs met the inclusion criteria. Conclusions: Across six small-to-moderate sized RCTs, platelet concentrates achieved high clinical survival and infection control comparable to BC. Radiographic outcomes (root length and wall thickening, apical closure, and periapical healing) were inconsistently reported and variably favored PRP/PRF or showed no between-group differences. Substantial methodological and clinical heterogeneity (protocols, imaging modalities, outcome definitions, and follow-up) limited quantitative synthesis. Standardized RET protocols and a core outcome set, with validated radiographic measurements (including CBCT where feasible), are needed to determine whether platelet concentrates provide clinically meaningful advantages over BC.

Keywords: Platelet-Rich Plasma; regenerative endodontic treatment; Immature teeth

Introduction

According to the findings of basic health research (riskesdas), dental and oral health issues, including pulp necrosis, affect 57.6% of Indonesians. Root growth stops in immature teeth with open apices that have necrotic pulp. The following conditions could result in necrotic pulp of juvenile teeth and stop root formation: dens evaginatus (25.9%), trauma (33.8%), and dental caries (12.9%). These circumstances result in a small, thin wall in the tooth root that is brittle. PRP holds promise as a biocompatible scaffold for regenerative endodontic therapy in immature necrotic teeth [1-3].

Treatment of necrotic immature teeth is complex and highly variable. This is due to the difficulty of cleaning necrotic debris from the root canal due to the wide and thin shape of the root canal and the apical end which is still not completely closed and the thickness of the dentin wall and the short root in young permanent teeth, causing easy fracture of the tooth root. The endodontic treatments that can be performed are conventional or regenerative endodontics [4].

Traditionally, an apexification technique utilizing calcium hydroxide to stimulate the creation of an apical barrier or apical plug MTA before to root canal filling is used to treat immature permanent teeth with necrotic pulp/apical periodontitis [5,6].

One major issue in endodontics has been the treatment of necrotic immature teeth. Because critical tissues regenerate, regenerative techniques allow for greater root development in terms of length and thickness compared to apexification [7-9].

When it comes to long-term structural stability, obturation, and canal disinfection, treating young necrotic teeth with blunderbuss apices with conventional endodontic therapy presents considerable clinical issues. A paradigm change has occurred in favor of PER, which permits teeth to continue developing following pulp necrosis in teeth that are still developing and offers advantages in terms of vitality and maturity [10,11].

Murray et al.[12] first proposed the term "RET" in 2007 using tissue engineering as a basis. RET is intended to regenerate pulp-like tissue in place of inflammatory or necrotic pulp tissue. Revascularization is currently the most often utilized RET in clinical practice. Revascularization is the process of extracting undifferentiated oral stem cells and molecules from the apical region and utilizing either platelet-rich plasma (PRP) or platelet-rich fibrin (PRF) after the root canal has been sufficiently disinfected to induce the formation of immature permanent teeth, or both [13-15].

PRP, a volume of autologous plasma with a high concentration of platelets, has been shown in several studies to be effective in creating scaffolds. It contains more growth factors that can promote stem cell proliferation for the induction of tissue healing and regeneration. PRP-released growth factors are crucial for controlling cellular processes such mitogenesis, chemotaxis, differentiation, and metabolism in order to promote healing. PRP is frequently used in several surgical specialties, including as oral and maxillofacial, cardiovascular, ENT, and head and neck surgery. PRP has been employed as a scaffold by a number of researchers in RET; Bezgin et al [16] and Torabinejad, Turman et al.[17] have all described instances in which PRP by itself can provide an effective scaffold, indicating PRP's ability to provide revascularization [15-23]. This systematic review summarizes randomized clinical evidence on PRP and PRF as scaffolds in RET, focusing on clinical success and radiographic indicators of root maturation and periapical healing.

Materials and Methods

We strictly followed the Cochrane Collaboration and PRISMA statement recommendations**.** The review procedure was prospectively recorded in the International Prospective Register of Systematic Reviews (PROSPERO) with the number CRD420251124902. For a regenerative endodontic surgery to be deemed successful, the American Association of Endodontists (AAE) identifies three primary goals that must be met: A positive vitality test result, (i) the resolution of clinical symptoms and signs and indications of bone healing, (ii) the continuation of root development in the form of longer and/or thicker root walls, and (iii)

PICO Question: The focal question and inclusion criteria were developed using the PICO technique: Population: 6–18 years old children whose permanent immature teeth of trauma or exposure to caries with or without AP. Intervention: PRP as a maturogenesis scaffold. Comparison: Platelet-rich fibrin and/or blood clots are comparable. Outcome: Evidence of apical bone healing, an increase in root length, and closure of the apical root. Focused question: When employed as a scaffold, does platelet rich PRP concentrate outperform PRF and BC in maturogenesis therapy outcomes?

Criteria for eligibility

Inclusion criteria were: (1) randomized controlled trials, prospective and retrospective trials; (2) patients aged between 7 and 18 years with young permanent teeth due to trauma or caries; (3) comparing platelet rich plasma versus platelet rich fibrin or blood clot; (4) reporting clinical and/or radiographic success of treated cases.

Exclusion criteria were: (1) Letters to the Editor, conference proceedings, literature reviews, and personal communications; (2) in vitro and animal studies; (3) case reports and case series, (4) in vivo studies that

did not report clinical success; and (5) studies that compared materials for reasons other than the use of platelet rich plasma.

Sources of information

From early 2015 to July 2025, we conducted searches on MEDLINE (PUBMED), Science direct, and Chocrane Library.

MEDLINE (PubMed) (searched Feb 28, 2025)

("regenerative endodontic" OR "endodontic regeneration" OR revascularization OR revitalization) AND ("platelet-rich plasma" OR "platelet rich plasma" OR PRP OR "platelet-rich fibrin" OR "platelet rich fibrin" OR PRF) AND (immature OR "open apex" OR "open apices"). Filters: Humans; English; 2015/02/01–2025/02/28.

Science Direct (searched Feb 28, 2025)

("regenerative endodontic" OR revascularization OR revitalization) AND ("platelet rich plasma" OR "platelet-rich plasma" OR PRP OR "platelet rich fibrin" OR "platelet-rich fibrin" OR PRF) AND (immature OR "open apex").

Cochrane Library (searched Feb 28, 2025)

("regenerative endodontic" OR revascularization OR revitalization) AND ("platelet-rich plasma" OR PRP OR "platelet-rich fibrin" OR PRF) AND (immature OR "open apex").

Data collection

Each reference was examined separately by two researchers (RAP, YI) based on the abstract and title. After applying particular inclusion and exclusion criteria to the complete texts of pertinent research, data were finally collected. Conflicts were settled by consensus; if not, a third reviewer (F) settled the issue. Title, year of publication, author names, study design, objective, inclusion and exclusion criteria, number of patients included, sample characteristics, loss to follow-up, outcomes, measure of association, and geographic location were all extracted from each reference by two calibrated reviewers working independently.

Risk of bias assessment

Risk of bias was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist, with the appropriate version selected based on study design: 13 items for RCTs. Each item was rated as "Yes," "No," "Unclear," or "Not Applicable." Two reviewers independently conducted the assessments and discrepancies were resolved through discussion. The overall risk of bias score for each study was calculated as the percentage of "Yes" responses out of the total applicable items, excluding "Not Applicable" responses [24-26].

Data synthesis

A narrative synthesis was conducted. Meta-analysis was not performed because of substantial heterogeneity in interventions, outcome measures, and imaging modalities (Table 4).

Results

Study Selection

The database search identified 432 records. After removal of 43 duplicates, 389 records were screened. Of these, 342 were excluded (wrong population, n=12; wrong study design, n=290; wrong publication type, n=22; wrong outcomes, n=12; non-English language, n=6). Forty-seven reports were sought for retrieval; 38 could not be retrieved. Nine full-text reports were assessed for eligibility and three were excluded, resulting in six included RCTs (Table 1 and 2) (Figure 1).

Characteristics of Included Studies

Six studies (Bezgin et al.,2015; Alagl, 2017; Ulusoy, 2019; Rizk, 2019; ElSheshtawy, 2020; Rizk, 2020) were included in this systematic review, published between 2015 and 2020. These studies compared BC vs. PRP as scaffolds in regenerative endodontics in immature teeth. The studies were conducted in Turkey, India, Saudi Arabia, and Egypt. All the studies included were randomized controlled clinical trials with a follow-up period ranging from 6 months to 18 months. All included studies focused on immature teeth diagnosed with pulp necrosis, with or without apical periodontitis (AP) [16,27,28,29,30,31].

Analysis of these studies suggests that while PRP creates an effective scaffold for regenerative endodontic treatment, the treatment outcomes were not significantly different from those using the conventional BC scaffold. Both approaches yielded similar results in terms of root closure and regeneration. Notably, although both the European Society of Endodontics and the American Association of Endodontics have recommended standardized protocols, most of the studies applied different protocols regarding intracanal irrigation and the composition of tri-antibiotic paste. The language of publication for all included studies was English.

Risk of Bias

All included studies clearly defined their treatment groups and employed appropriate intervention procedures. However, none of the studies adequately reported on the presence of a control group not exposed to the intervention, which constitutes a potential source of bias in the internal validity of quasi-experimental animal research. Furthermore, while most studies used consistent and reliable outcome measures, there was limited information regarding the use of multiple pre- and post-intervention measurements (Q2), which may affect the robustness of time-based comparisons. Importantly, all studies demonstrated high methodological consistency in treatment administration (Q4), outcome measurement reliability (Q6), and the use of appropriate statistical analysis (Q9). Nevertheless, the lack of blinding and limited reporting on confounding factors (Q5) represent moderate limitations that should be considered when interpreting the results. Despite these methodological constraints, all studies reported complete outcome data with minimal loss to follow-up and analyzed participants in the groups to which they were assigned. This indicates a generally low risk of attrition and selection bias (Table 3).

Taken together, the findings suggest that the included quasi-experimental animal studies provide moderately reliable evidence, with methodological strengths in consistency of intervention and measurement, but with notable limitations in randomization control and confounder reporting.

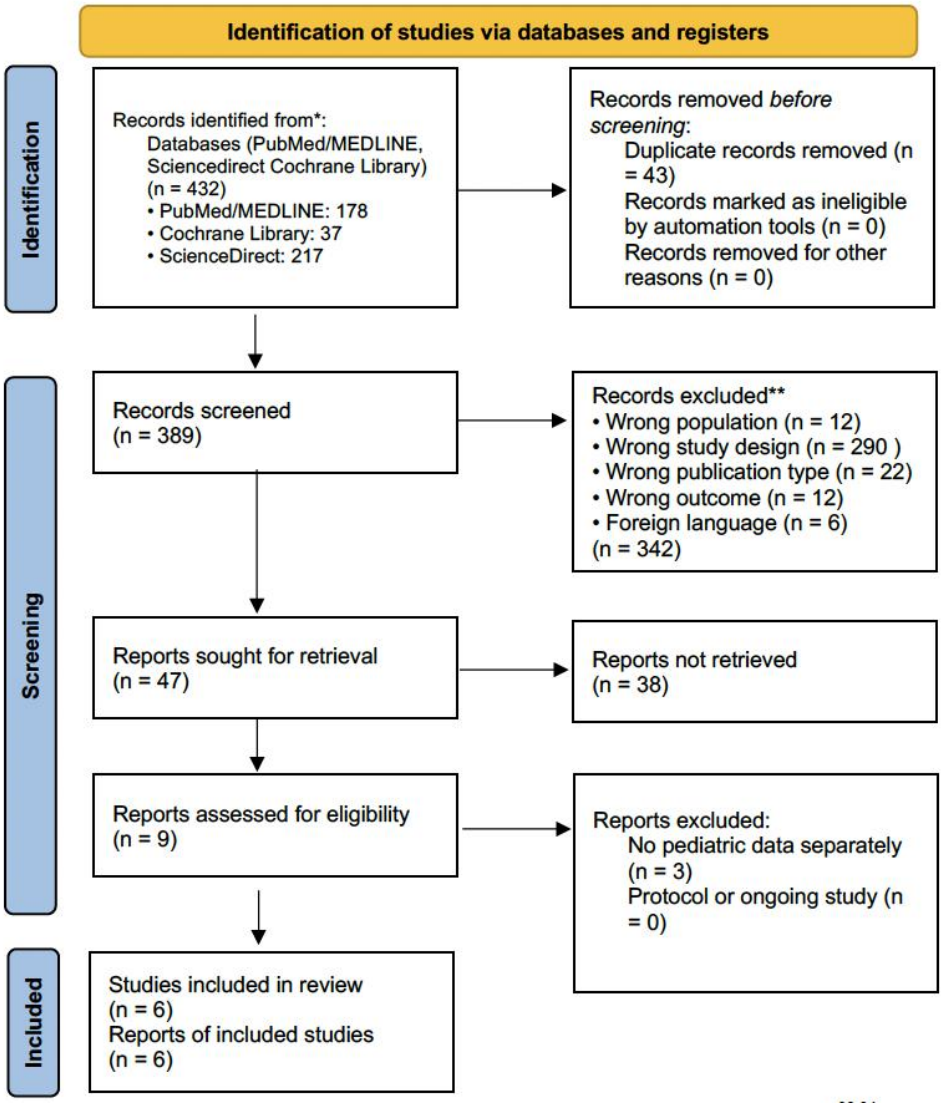

Figure 1. Prisma 2020 flow diagram of study selection [32,33].

Table 1. Characteristics of Included Studies on Platelet-Rich Plasma as a Scaffold in Regenerative Endodontics

Author, year	Sample	Age	Comparison	Study design	Follow up (month)
Tugba Bezgin, et al/ 2015 [16]	22	7-13 years	BC	RCT	18
Adel Alagl, Sumit Bedi et al/ 2017 [27]	30	8-14 years	BC (MTA as a corona seal)	Split-mouth randomized clinical trial	12
Ulusoy AT, Turedi et al / 2019 [28]	88	8-11 years	PRF, BC	Prospective randomized clinical trial	12
Hazim Mohamed Rizk, et al / 2019 [29]	26	8-14 years	BC	Split-mouth double-blinded randomized controlled trial	12
ElSheshtawy K., et al/ 2020 [30]	30	8-12 years	BC	Randomized controlled clinical trial	12
Hazim Mohamed Rizk, et al / 2020 [31]	26	9 ± 1	PRF	Double-blinded randomized controlled trial	12

Table 2. Data synthesis table

Author, year	Apical Closure time (month)			Increase in Root Area (%)			Radiograph succes rate (%)			Findings
	PRP	PRF	BC	PRP	PRF	BC	PRP	PRF	BC	
Tugba Bezgin, et al/ 2015 (16)	8.1	NS	9	9.86	NS	12.06	100	NS	90	PRP in apical closure is faster than BC
Adel Alagl, Sumit Bedi et al/ 2017 (27)	6	NS	3-12	+9.6%	NS	+4.4%	100	NS	100	PRP accelerates apical closure and improves root growth compared to BC
Ulusoy AT, Turedi et al / 2019 (28)	4.85 ± 1.51	5.27 ± 1.82	11 ± 2.11	9.53	6.93	15.79	86	86	86	PRP in apical closure is faster than PRF and BC
Hazim Mohamed Rizk, et al / 2019 (29)	64.83% reduction in apical diameter	NS	53.45% reduction in apical diameter	+9.88%	NS	+4.68	100	NS	100	PRP significantly increased root length, root thickness, bone density, and apical closure compared to BC
ElSheshtawy K., et al/ 2020 (30)	12	NS	12	+10.6	NS	+10.6	85.7% at 6 months (90% total if dropouts are counted as cured	NS	88% at 6 months	PRP significantly enhanced root development compared to BC
Hazim Mohamed Rizk, et al / 2020 (31)	12	12	NS	+9.88	+8.19	NS	100	100	NS	PRP was slightly superior in root length growth and the incidence of crown discoloration PRF was slightly higher in root wall thickening

Table 3. Risk of bias of randomized controlled animal studies assessed with the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Randomized Controlled Trials

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Score % (category)
Tugba Bezgin 2015 (16)	✓	✓	✓	⊖	⊖	⊖	✓	✓	⊖	✓	✓	✓	✓	77.8% (moderate)
Adel 2017 (27)	✓	✓	✓	⊖	⊖	⊖	✓	✓	⊖	✓	✓	✓	✓	77.8% (moderate)
Ulusoy 2019 (28)	✓	✓	✓	⊖	⊖	⊖	✓	✓	⊖	✓	✓	✓	✓	77.8% (moderate)
Hazim 2019 (29)	✓	✓	✓	⊖	⊖	⊖	✓	✓	⊖	✓	✓	✓	✓	77.8% (moderate)
ElSheshtawy K 2020 (30)	✓	✓	✓	⊖	⊖	⊖	✓	✓	⊖	✓	✓	✓	✓	77.8% (moderate)
Hazim 2020 (31)	✓	✓	✓	⊖	⊖	⊖	✓	✓	⊖	✓	✓	✓	✓	77.8% (moderate)
Average														77.8% (moderate)

Abbreviations/Scoring (journal-ready): ✓= Yes (criterion met; low risk of bias); × = No (not met; high risk of bias); ? = Unclear/insufficient information; ⊖ = Not applicable (e.g., participant/personnel blinding and ITT often not feasible/relevant in animal tooth-extraction models).

Heterogeneity assessment

Clinical and methodological heterogeneity was present across studies in population/etiology, disinfection protocols, scaffold preparation, imaging modality (2D vs CBCT), and outcome definitions (Table 4), precluding pooling of results.

Table 4. Sources of heterogeneity across included trials and impact on synthesis.

Domain	Examples of variation across trials	Impact on comparability	Overall judgement
Population/etiology	Trauma-only vs mixed etiology; different baseline periapical status; variable numbers of teeth per patient	Different healing potential and baseline anatomy	Moderate–High
RET disinfection protocol	Irrigant concentrations, use/duration of intracanal medicaments (triple antibiotic paste vs calcium hydroxide), and coronal seal materials differed	Affects stem cell survival and outcomes	High
Scaffold interventions	PRP protocols (spin methods/activation), PRF type, platelet pellet; some trials compared >2 scaffolds	Intervention not uniform across trials	High
Outcome definitions and imaging	2D radiographs vs CBCT; different measurement software; use of root area vs linear metrics; different definitions for apical closure/healing	Prevents direct pooling of effect sizes	High
Follow-up and timepoints	12 vs 18 months; different follow-up intervals	May miss late root maturation or failures	Moderate

Discussion

Regenerative endodontics is one of the treatments developed in the field of dentistry and the concept of regenerative endodontics is defined as one of the biologically based treatments designed to replace damaged structures such as root structure, dentin and dentin-pulp complex cells and to induce normal dental pulp function. The specific goal of regenerative endodontic treatment is to induce root development so that the tooth apex can close completely and there is an increase in root wall thickness and tooth root elongation and induce normal dental pulp function. One of the concepts and parts of regenerative endodontic treatment procedures for necrotic immature teeth is revascularization treatment. This procedure introduces a scaffold or biological procedure inside the root canal to encourage the formation of vital tissues that will continue mineral deposition to strengthen dentin and promote the growth of rudimentary tooth roots[4,34].

Using PRP may help clinicians treating hundreds of wounded immature teeth with REP find a tiny improvement in treatment success rate. One possible drawback of use PRP instead of BCR is the higher expense and preparation time associated with PRP. Clearly, a child who refuses to have venous blood

collected from their arm due to trypanophobia (fear of needles) or hemophobia (fear of seeing blood) is not a good candidate for a platelet-rich plasma treatment [16,34].

Badade et al. [35] assessed PRP and PRF's antibacterial efficacy. He discovered that PRP outperformed PRF in terms of antibacterial activity. Kour et al. [36] further validated this finding. One explanation could be that the concentration of platelets and leukocytes in PRF is lower than in PRP. Moreover, as the fibrin network disintegrates in PRP, platelets and cytokines will be completely liberated. However, in contrast to PRP's quick, single release of growth factors, PRF offers a delayed and continuous release of growth factors. As a result, PRF could take longer than PRP to start working better [35,36].

PRP is the best option when it comes to scaffolding materials for regenerative endodontic treatment, according to a study by Rizk et al. [31]. This is due to the fact that during bone density measurements, it was seen that the PRP group consistently had higher average bone density than the PRF group. ElSheshtawy et al. [30] assessed PRP better clinical and radiographic outcomes PRP at 12-month follow- up. There was no statistically significant difference. The research supported the findings of Shivashankar et al [37]. Narang et al. [38] and Maha Mohamed Abo Haikal [39] in terms of periapical region healing, PRP performed just slightly better than PRF. This is explained by PRP's liquid state, which makes it possible for it to enter the periapical area unimpeded [37,38]. In contrast, PRF helps transfer the maximum quantity of growth factors to hasten the wound healing process and has a gel-like consistency [31].

According to some claims and reports from various earlier studies and practitioners, the difficulty of treating children's immature teeth with endodontic regenerative therapy is related to the duration of pulp necrosis. This means that the treatment will yield fewer results, such as an increase in root wall thickness or an increase in root length and apical closure [4].

This review found that autologous platelet concentrates (PRP/PRF) used as scaffolds within RET protocols generally achieve high clinical success rates comparable to conventional induced blood clot scaffolds. However, whether platelet concentrates confer additional radiographic benefits remains uncertain because trials reported heterogeneous endpoints and inconsistent between-group differences.

Potential biological advantages of platelet concentrates include higher concentrations of growth factors and a fibrin matrix that may support cell migration and angiogenesis. In practice, any benefit may be obscured by protocol variability (irrigation/medication), baseline lesion size, and differences in imaging methods and measurement approaches. Trials that used CBCT alongside 2D radiographs illustrate that outcome estimates may differ by modality and standardization, emphasizing the need for harmonized radiographic assessment.

Future RCTs should standardize RET protocols, report core outcomes (root length, dentinal wall thickness, apical closure, and periapical healing) using validated measurement methods, and ensure adequate allocation concealment and blinded outcome assessment. Reporting of adverse events such as crown discoloration should be consistent across studies.

Limitation

The evidence base is limited by small sample sizes, inconsistent reporting of baseline tooth characteristics, and variability in RET protocols and imaging modalities. Restricting inclusion to RCTs improved internal validity but reduced the number of eligible studies. Meta-analysis was not possible because of substantial heterogeneity, and publication bias could not be meaningfully assessed with fewer than ten studies.

Conclusion

Within the available randomized evidence, PRP and PRF scaffolds in regenerative endodontic therapy show clinical outcomes comparable to blood clot scaffolds, with inconsistent radiographic

advantages. Well-designed, adequately powered trials with standardized protocols and agreed radiographic endpoints are required before routine preference for platelet concentrates over blood clot scaffolds can be recommended.

Conflict of interest

None.

Authors' contributions

RAP prepared the materials, collected the data, and analyzed them. The first draft of the manuscript was authored by RAP and YI. While F, AS, GAC, and AW provided feedback on prior versions. All authors helped to conceptualize and plan the study, as well as evaluate and approve the final paper.

Acknowledgment and funding

The authors are sincerely thankful to all staff of the Department of Pediatric Dentistry, Faculty of Dentistry, Hasanuddin University, for their support and assistance during the preparation of this systematic review This study received no funding from either the government or the business sector.

Informed consent

Consent for participating in this type of study does not involve formal consent.

References

1. Suwartini T. Revaskularisasi gigi: Prosedur Perawatan Potensial untuk Regenerasi Gigi Nekrosis Pulpa Apeks Terbuka (Tinjauan Pustaka). Jurnal Kedokteran Gigi Terpadu. 2020 Jan 1. https://doi.org/10.25105/jkgt.v1i2.6392

2. Andreasen J, Borum M, Jacobsen H, Andreasen F. Replantation of 400 avulsed permanent incisors. 1. Diag healing comp. Endod & dent traumatol. 1995;11:51-8. https://doi.org/10.1111/j.1600-9657.1995.tb00461.x

3. Albuquerque MTP, Nagata JY, Soares ADJ, Zaia AA. Pulp revascularization: An alternative treatment to the apexification of immature teeth. Rev Gaúch Odontol. 2014;62(4):401-10. https://doi.org/10.1590/1981-86372014000400000082673

4. Wahluyo S. Endodontik Regeneratif pada Gigi Imatur Anak. Surabaya: CV. Revka Prima Media; 2023 :2-6, 101-7. ISBN: 978-602-417-314-2

5. Kim SG, Malek M, Sigurdsson A, Lin LM, Kahler B. Regenerative endodontics: a comprehensive review. Inter endo J. 2018 Dec;51(12):1367-88. https://doi.org/10.1111/iej.12954

6. Chala S, Abouqal R, Rida S. Apexification of immature teeth with calcium hydroxide or mineral trioxide aggregate: systematic review and meta-analysis. Oral Surg Oral Med Oral Patho Oral Radio Endo. 2011 Oct 1;112(4):e36-42. https://doi.org/10.1016/j.tripleo.2011.03.047

7. Caleza-Jiménez C, Ribas-Pérez D, Biedma-Perea M, Solano-Mendoza B, Mendoza-Mendoza A. Radiographic differences observed following apexification vs revascularization in necrotic immature molars and incisors: a follow-up study of 18 teeth. European Archives of Paediat Dent. 2022 Jun 1;23(3):381-9. https://doi.org/10.1007/s40368-022-00692-z

8. Nicoloso GF, Pötter IG, Rocha RD, Montagner F, Casagrande L. A comparative evaluation of endodontic treatments for immature necrotic permanent teeth based on clinical and radiographic outcomes: a systematic review and meta‐analysis. Inter J Pediatr Dent. 2017 May;27(3):217-27. https://doi.org/10.1111/ipd.12261

9. Shabahang S. Treatment options: apexogenesis and apexification. Pediatr Dent. 2013;35:125-128. https://doi.org/10.1016/j.joen.2012.11.046

10. Lui JN, Lim WY, Ricucci D. An Immunofluorescence Study to Analyze Wound Healing Outcomes of Regenerative Endodontics in an Immature Premolar with Chronic Apical Abscess. J Endod. 2020 May 1;46(5):627-40. https://doi.org/10.1016/j.joen.2020.01.015

11. Trope M. Treatment of the immature tooth with a non-vital pulp and apical periodontitis. Dent Clin North Am 2010;54:313-24. https://doi.org/10.1016/j.cden.2009.12.006

12. Murray PE, Garcia-Godoy F, Hargreaves KM. Regenerative endodontics: a review of current status and a call for action. J Endod. 2007;33(4):377-390. https://doi.org/10.1016/j.joen.2006.09.013

13. Wei Y, Lyu P, Bi R, Chen X, Yu Y, Li Z, et al. Neural Regeneration in Regenerative Endodontic Treatment: An Overview and Current Trends. Inter J Molec Sci MDPI 2022;23:1-29. https://doi.org/10.3390/ijms232415492

14. Eramo S, Natali Am Pinna R, Milia E. Dental pulp regeneration via cell homing. Int. Endod. J. 2018, 51, 405-419. https://doi.org/10.1111/iej.12868

15. Xie Z, Shen Z, Zhan P, Yang J, Huang Q, Huang S, et al. Functional Dental Pulp Regeneration: Basic Research and Clinical Translation. Int. J. Mol. Sci. 2021, 22, 8991. https://doi.org/10.3390/ijms22168991

16. Bezgin T, Yilmaz AD, Celik BN, Kolsuz ME, Sonmez H. Efficacy of platelet-rich plasma as a scaffold in regenerative endodontic treatment. J Endod. 2015 Jan 1;41(1):36-44. https://doi.org/10.1016/j.joen.2014.10.004

17. Torabinejad M, Turman M. Revitalization of tooth with necrotic pulp and open apex by using platelet-rich plasma: a case report. J Endod 2011;37:265-8. https://doi.org/10.1016/j.joen.2010.11.004

18. Jadhav GR, Shah N, Logani A. Revascularization with and without platelet-rich plasma in nonvital, immature, anterior teeth: a pilot clinical study. J Endod 2012; 38:1581-7. https://doi.org/10.1016/j.joen.2012.09.010

19. Bezgin T, Yılmaz AD, Celik BN, Sönmez H. Concentrated platelet-rich plasma used in root canal revascularization: 2 case reports. Int Endod J 2014;47:41-9. https://doi.org/10.1111/iej.12144

20. Jadhav GR, Shah N, Logani A. Comparative outcome of revascularization in bilateral, non-vital, immature maxillary anterior teeth supplemented with or without platelet rich plasma: a case series. J Conserv Dent 2013;16:568-72. https://doi.org/10.4103/0972-0707.120932

21. Martin G, Ricucci D, Gibbs JL, Lin LM. Histological findings of revascularized/revitalized immature permanent molar with apical periodontitis using platelet-rich plasma. J Endod 2013;39:138-44. https://doi.org/10.1016/j.joen.2012.09.015

22. Nikolidakis D, Jansen JA. The biology of platelet-rich plasma and its application in oral surgery: literature review. Tissue Eng Part B Rev. 2008;14(3):249-258. https://doi.org/10.1089/ten.teb.2008.0062

23. Alsousou J, Ali A, Willett K, Harrison P. The role of platelet-rich plasma in tissue regeneration. Platelets 2013;24:173-82. https://doi.org/10.3109/09537104.2012.684730

24. Barker TH, Stone JC, Sears K, Klugar M, Tufanaru C, Leonardi-Bee J, et al. The revised JBI critical appraisal tool for the assessment of risk of bias for randomized controlled trials. JBI evidence synth. 2023 Mar 1;21(3):494-506. https://doi.org/10.11124/JBIES-22-00430

25. Barker TH, Habibi N, Aromataris E, Stone JC, Leonardi-Bee J, Sears K, et al. The revised JBI critical appraisal tool for the assessment of risk of bias for quasi-experimental studies. JBI Evid Synth. 2024;22(3). https://doi.org/10.11124/JBIES-23-00268

26. Moola S, Munn Z, Tufanaru C, Aromataris E, Sears K, Sfetcu, R, et al. Checklist for analytical cross sectional studies. Joanna Briggs Institute Reviewer's Manual. Published online 2017:1-7.

27. Alagl A, Bedi S, Hassan K, AlHumaid J. Use of platelet-rich plasma for regeneration in non-vital immature permanent teeth: Clinical and cone-beam computed tomography evaluation. J Inter Med Res. 2017 Apr 1;45(2):583-93. https://doi.org/10.1177/0300060517692935

28. Ulusoy AT, Turedi I, Cimen M, Cehreli ZC. Evaluation of blood clot, platelet-rich plasma, platelet-rich fibrin, and platelet pellet as scaffolds in regenerative endodontic treatment: a prospective randomized trial. J Endod. 2019;45(5):560-566. https://doi.org/10.1016/j.joen.2019.02.002

29. Rizk HM, Al-Deen MSS, Emam AA. Regenerative Endodontic Treatment of Bilateral Necrotic Immature Permanent Maxillary Central Incisors with Platelet-rich Plasma versus Blood Clot: A Split Mouth Double-blinded Randomized Controlled Trial. Int J Clin Pediatr Dent. 2019 Jul 1;12(4):332-9. https://doi.org/10.5005/jp-journals-10005-1656

30. ElSheshtawy AS, Nazzal H, El Shahawy OI, El Baz AA, Ismail SM, Kang J, et al. The effect of platelet-rich plasma as a scaffold in regeneration/revitalization endodontics of immature permanent teeth assessed using 2-dimensional radiographs and cone

beam computed tomography: a randomized controlled trial. Int Endod J. 2020 Jul 1;53(7):905-21. https://doi.org/10.1111/iej.13303

31. Rizk HM, Salah Al-Deen MSM, Emam AA. Comparative evaluation of Platelet Rich Plasma (PRP) versus Platelet Rich Fibrin (PRF) scaffolds in regenerative endodontic treatment of immature necrotic permanent maxillary central incisors: A double blinded randomized controlled trial. Saudi Dent J. 2020 Jul 1;32(5):224-31. https://doi.org/10.1016/j.sdentj.2019.09.002

32. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. https://doi.org/10.1136/bmj.n71

33. Page MJ, Moher D, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. BMJ. 2021;372. https://doi.org/10.1136/bmj.n160

34. Murray PE. Review of guidance for the selection of regenerative endodontics, apexogenesis, apexification, pulpotomy, and other endodontic treatments for immature permanent teeth. Vol. 56, Inter Endo J. John Wiley and Sons Inc; 2023. p. 188-99. https://doi.org/10.1111/iej.13809

35. Badade PS, Mahale SA, Panjwani AA, Vaidya PD, Warang AD. Antimicrobial effect of platelet-rich plasma and platelet-rich fibrin. Indian J Dent Res. 2016;27(3):300-4. https://doi.org/10.4103/0970-9290.186231

36. Kour P, Pudakalkatti PS, Vas AM, Das S, Padmanabhan S. Comparative evaluation of antimicrobial efficacy of platelet-rich plasma, platelet-rich fibrin, and injectable platelet-rich fibrin on the standard strains of Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans. Contemp Clin Dent. 2018 Sep 1;9(6):325-30. https://doi.org/10.4103/ccd.ccd_367_18

37. Shivashankar VY, Johns DA, Maroli RK, Sekar M, Chandrasekaran R, Karthikeyan S, et al. Comparison of the effect of PRP, PRF and induced bleeding in the revascularization of teeth with necrotic pulp and open apex: A triple blind randomized clinical trial. J Clin Diag Res. 2017 Jun 1;11(6):ZC34-9. https://doi.org/10.7860/JCDR/2017/22352.10056

38. Narang I, Mittal N, Mishra N. A comparative evaluation of the blood clot, platelet-rich plasma, and platelet-rich fibrin in regeneration of necrotic immature permanent teeth: A clinical study. Contemp Clin Dent. 2015 Jan 1;6(1):63-8. https://doi.org/10.4103/0976-237X.149294

39. Abo - Heikal MM, El - Shafei JM, Shouman SA, Roshdy NN. Evaluation of the efficacy of injectable platelet - rich fibrin versus platelet - rich plasma in the regeneration of traumatized necrotic immature maxillary anterior teeth: A randomized clinical trial. Dent Traumatol. 2024 Feb 23;40(1):61-75. https://doi.org/10.1111/edt.12881

من الدم إلى البيولوجيا: تقييم البلازما الغنية بالصفائح الدموية كسقالة في طب الأسنان التجديدي \ مراجعة منهجية

ريستي ألو بادانغ، يايه إناية، فاجرياني، أغنيتا شريف، غيسكا أناندیتا كاهياني، أندي واهيوني

المستخلص

مع الخثرة الدموية المُستحثة ([PRF] والفيبرين الغني بالصفائح الدموية [PRP] البلازما الغنية بالصفائح الدموية) **الأهداف:** مقارنة مُركزات الصفائح الدموية الذاتية للأسنان الدائمة غير مكتملة الجذور المصابة بنخر اللب (RET) وغيرها من طرائق السقالات في العلاج اللبّي التجديدي التقليدية (BC). **البيانات:** التجارب العشوائية المُحكّمة (RCTs) التي تُبلغ عن النتائج السريرية و/أو القياسات الشعاعية لاستمرار تطور الجذر (مثل طول الجذر، سماكة جدار العاج، انغلاق الذروة، وشفاء ما حول الذروة (بعد RET). **المصادر:** أُجري بحثٌ منهجي في قواعد بيانات للدراسات المنشورة من فبراير/شباط Google Scholar وWeb of Science وScopus وPubMed/MEDLINE إلى فبراير/شباط 2025. كما جرى البحث يدويًا في قوائم المراجع للدراسات المُدرجة. اتبعت المراجعة إرشادات الإبلاغ وفق PRISMA 2020. **اختيار الدراسات:** شملت الدراسات المؤهلة تجارب عشوائية بشرية قيّمت RET في الأسنان الدائمة غير مكتملة الجذور المصابة بنخر اللب كسقالة لـ PRF و/أو PRP، مقارنة بسقالة أخرى مشتقة من الصفائح (BC). قام مُراجعان بفحص الدراسات واختيارها بشكل مستقل. استوفت ستّ تجارب عشوائية معايير الاشتمال (أو سقالة أخرى مشتقة من الصفائح BC) مع وجود سقالة مقارنة. **الاستنتاجات:** عبر ستّ تجارب عشوائية صغيرة إلى متوسطة الحجم، حققت مُركزات الصفائح الدموية معدل بقاء سريريًا مرتفعًا وضبطًا للعدوى مماثلاً لـ BC. أما PRP/PRF أو عدم النتائج الشعاعية (طول الجذر وزيادة سماكة الجدار، انغلاق الذروة، وشفاء ما حول الذروة) فقد أُبلغ عنها بشكل غير متسق وتباينت بين تفضيل وجود فروق بين المجموعات. كما حدّ التغاير المنهجي والسريري الكبير (البروتوكولات، طرائق التصوير، تعريفات النتائج، وفترات المتابعة) من إمكانية إجراء توليف مع قياسات شعاعية مُعتمدة (بما في ذلك التصوير المقطعي بالحزمة المخروطية CBCT) معيارية ومجموعة نتائج أساسية (core outcome set)، كمي RET. هناك حاجة إلى بروتوكولات عند الإمكان(، لتحديد ما إذا كانت مُركزات الصفائح الدموية توفر مزايا سريرية ذات معنى مقارنةً بـ BC.