E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.48047/ijprt/16.01.30

Research Article

BIODENTINE PULPOTOMY ALTERNATE TO ROOT CANAL TREATMENT IN YOUNG ADULTS

Amara Nazir, Prof. Dr. Mehvish Saleem, Dr Sana Akram, Dr. Faisal Asghar, Dr. Marryam Quddus, Dr. Waqas Qasim

[1]Associate Professor Operative Dentistry, Bakhtawer Amin Medical and Dental College Multan, amarafaisal1234@gmail.com

[2]Associate Professor Department of Science of Dental Materials Bakhtawar Amin, College of Dentistry Multan

mehvish.saleem@faculty.bamdc.edu.pk

[3]Associate Professor, Azra Naheed Dental College Lahore, dr.sana.ahtesham@gmail.com

[4]Assistant Professor Oral Medicine, Multan Medical and Dental College, faisalmmdc@gmail.com

[5]House Officer, Bakhtawar Amin Medical and Dental Hospital, Multan, marryam.quddus2320@gmail.com

[6]House Officer, Bakhtawar Amin Medical and Dental Hospital, Multan, wk55601@gmail.com

Corresponding Author: Associate Professor Operative Dentistry, Bakhtawer Amin Medical and Dental College Multan, amarafaisal1234@gmail.com

ABSTRACT

Background: Vital pulp therapy using Biodentine has emerged as a biologically conservative alternative to root canal treatment, especially in young adults with irreversible pulp inflammation. Objective: This study aimed to evaluate the clinical and radiographic success of Biodentine pulpotomy in young adult patients over a six-month follow-up period. Methodology: This prospective clinical study was conducted at Bakhtawer Amin Medical and Dental College Multan from April 2024 till January 2025 included 32 patients aged 8 to 30 years who underwent Biodentine pulpotomy for vital permanent teeth diagnosed with irreversible pulpitis or trauma-induced exposure. Standard aseptic protocol was followed, and Biodentine was placed as a pulpal capping material before final restoration. Clinical and radiographic evaluations were performed at one week, three months, and six months. Results: The mean age of patients was 17.4 ± 5.6 years, with the majority (40%) belonging to the 16–22-year age group. Mandibular molars were the most frequently treated teeth (46.9%), followed by maxillary molars (31.3%) and premolars (21.8%). Clinical evaluation showed complete pain relief in all patients after one week, with a success rate of 93.8% at three months and 90.6% at six months. Radiographically, 81.3% of treated teeth exhibited complete dentin bridge formation, while 9.4% showed partial mineralization and 9.4% showed signs of periapical radiolucency. Conclusion: Biodentine pulpotomy demonstrates high clinical and radiographic success in maintaining pulp vitality and promoting healing in young adults. Its superior biocompatibility, sealing ability, and dentinogenic potential make it an excellent alternative to conventional root canal therapy in appropriately selected cases.

Keywords: Biodentine, pulpotomy, vital pulp therapy, dentin bridge, young adults, root canal

INTRODUCTION

Preservation of pulp vitality has emerged as one of the most significant advancements in contemporary restorative dentistry [1]. The traditional treatment of irreversible pulpitis or deep carious lesions in young adults often involves root canal therapy (RCT), which,

although effective in eliminating infection, sacrifices the natural vitality of the pulp [2]. The introduction of bioactive dentin substitutes like Biodentine has transformed the approach to vital pulp therapy by offering a biologically driven alternative that promotes healing and preserves tooth vitality [3]. Biodentine pulpotomy is now being increasingly recognized as a definitive, minimally invasive alternative to RCT, especially in cases where the radicular pulp remains healthy and capable of recovery [4]. Pulp vitality preservation is essential not only for maintaining sensory function but also for supporting the physiological role of the tooth. The dental pulp provides immune defense, responds to noxious stimuli through reparative dentinogenesis, and maintains the hydration of dentin [5]. Root canal treatment, while successful in eradicating infection, can lead to a brittle tooth structure, increased fracture susceptibility, and loss of proprioceptive feedback [6]. In contrast, pulpotomy with bioactive materials aims to remove only the infected coronal pulp tissue while preserving the vitality of the radicular pulp, thereby maintaining the tooth's biological and mechanical integrity. Biodentine, a tricalcium silicate–based cement developed as a dentin replacement material, is gaining attention due to its biocompatibility, bioactivity, and sealing ability [7]. Its composition includes tricalcium silicate, dicalcium silicate, and calcium carbonate, with calcium chloride acting as a setting accelerator. On contact with tissue fluids, Biodentine releases calcium hydroxide, which stimulates odontoblast-like cell differentiation and promotes reparative dentin formation [8]. Unlike conventional calcium hydroxide, Biodentine offers superior mechanical properties, including high compressive strength and reduced solubility, making it an ideal long-term restorative option [9]. Its short setting time and excellent sealing ability against microleakage further enhance its clinical applicability in vital pulp therapy. In young adult patients, the potential for pulp regeneration is high due to rich vascularity and cellular activity. Biodentine pulpotomy leverages this biological advantage to stimulate natural healing processes [10]. Multiple studies have shown that Biodentine induces the formation of a thick, continuous dentin bridge with minimal tunnel defects and less inflammation than materials like mineral trioxide aggregate (MTA). Clinical trials have reported success rates exceeding 90% at one year, with maintained pulp vitality, absence of periapical pathology, and continued root development in immature teeth [11]. From a clinical perspective, Biodentine pulpotomy offers several practical advantages over RCT. It requires less chair time, fewer instruments, and reduced operator skill, making it a cost-effective option [12]. The procedure involves minimal removal of tooth structure, lowering the risk of structural weakening. Additionally, because Biodentine closely mimics dentin's mechanical properties, it provides a more natural interface between pulp and restoration. For patients, the reduced postoperative discomfort and lower treatment cost enhance acceptability, particularly among young adults seeking conservative care [13].

Objective

TThis study aimed to evaluate the clinical and radiographic success of Biodentine pulpotomy in young adult patients over a six-month follow-up period.

Methodology

This prospective clinical study was conducted at Bakhtawer Amin Medical and Dental College Multan from April 2024 till January 2025 included 32 patients aged 8 to 30 years who underwent Biodentine pulpotomy for vital

permanent teeth diagnosed with irereversible pulpitis or trauma-induced exposure. Non-probability consecutive sampling was used to recruit patients who fulfilled the inclusion and exclusion criteria until the desired sample size was achieved. Patients aged between 8 and 30 years with deep carious lesions or mechanical pulp exposure in permanent teeth were included. Only teeth with vital pulps showing positive responses to electric and thermal pulp testing, no spontaneous or lingering pain, and no radiographic evidence of periapical pathology were selected. Hemostasis within 5 minutes after coronal pulp removal was also required for inclusion. Patients with teeth showing signs of periapical or furcal radiolucency, internal or external root resorption, necrotic pulp, sinus, or previously treated and restored teeth were excluded. Patients with systemic diseases, immunocompromised conditions, or poor oral hygiene were also excluded.

Data collection

Informed consent was obtained from all patients or guardians before treatment. Local anesthesia was administered, and the tooth was isolated using a rubber dam. Caries and unsupported enamel were removed with a sterile diamond bur under copious water cooling. The coronal pulp tissue was removed using a sterile round bur at low speed and then disinfect with 0.5% hypochlorite solution. Bleeding was controlled with a sterile moist cotton pellet applied for approximately 5 minutes. After achieving hemostasis, Biodentine (Septodont, France) was prepared according to the manufacturer's instructions and applied over the pulp stumps in a 2-mm layer. Once the Biodentine began setting, the cavity was sealed with a resin-modified glass ionomer cement (RMGIC) base, followed by composite resin restoration in the same appointment. Patients were recalled after 1 week, 3 months, and 6 months. Clinical assessment included evaluation for spontaneous pain, tenderness on percussion, swelling, and restoration integrity. Vitality testing was performed at each recall visit using an electric pulp tester. Standardized periapical radiographs were obtained at baseline and follow-up to assess dentin bridge formation, pulp canal obliteration, and any signs of periapical changes. The primary outcome was clinical and radiographic success of Biodentine pulpotomy, defined by the absence of symptoms, maintenance of pulp vitality, and lack of periapical or internal resorption. Secondary outcomes included postoperative pain levels and radiographic evidence of reparative dentin bridge formation.

Data Analysis

All collected data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. Quantitative data such as age, duration of hemostasis, and postoperative pain scores were expressed as mean ± standard deviation. Qualitative variables such as gender, tooth type, and treatment outcome were presented as frequencies and percentages. Associations between categorical variables were evaluated using chi-square and Fisher's exact tests. A p-value < 0.05 was considered statistically significant.

Results

Data were collected from 32 patients, with a mean age of 18.4 ± 5.6 years. The majority of participants (40.6%) were between 16 and 22 years old, followed by 8–15 years (28.1%) and 23–30 years (31.3%). Males constituted 56.3% and females 43.7% of the sample. Mandibular molars were the most frequently treated teeth (46.9%), followed by maxillary molars (31.3%) and premolars (21.8%). The average duration of preoperative symptoms was 4.2 ± 1.7 days,

indicating that most patients sought treatment within a short period of symptom onset.

Table 1. Baseline Demographic and Clinical Characteristics of Patients (n = 32)

Variable	Category / Mean ± SD	n (%)
Age (years)	18.4 ± 5.6	—
Age group	8–15 years	9 (28.1)
16–22 years	13 (40.6)	
23–30 years	10 (31.3)	
Gender	Male	18 (56.3)
	Female	14 (43.7)
Tooth type	Mandibular molar	15 (46.9)
	Maxillary molar	10 (31.3)
	Premolar	7 (21.8)
Duration of symptoms (days)	4.2 ± 1.7	—

Postoperative outcomes were highly favorable. At one week, all 32 teeth (100%) were asymptomatic, and only two patients (6.3%) experienced mild transient pain that resolved spontaneously. By three months, 93.8% of patients remained symptom-free, and by six months, the success rate improved to 96.9%.

Table 2. Clinical Findings and Postoperative Symptoms Following Biodentine Pulpotomy

Parameter	1 Week	3 Months	6 Months
Asymptomatic teeth	32 (100%)	30 (93.8%)	31 (96.9%)
Mild postoperative pain	2 (6.3%)	0 (0%)	0 (0%)
Tenderness on percussion	0 (0%)	2 (6.3%)	1 (3.1%)
Swelling / abscess	0 (0%)	0 (0%)	0 (0%)

At the three-month follow-up, dentin bridge formation was evident in 75% of cases, which further increased to 84.4% at six months. The remaining teeth maintained normal periapical architecture, and no instances of internal or external resorption were recorded. Only one case (3.1%) exhibited periapical radiolucency at six months, suggesting early treatment failure, but overall radiographic success strongly correlated with pulpal healing and Biodentine's regenerative properties

.

Table 3. Radiographic Evaluation at Follow-Up

Radiographic Finding	3 Months n (%)	6 Months n (%)
Dentin bridge formation	24 (75.0)	27 (84.4)
Normal periapical architecture	8 (25.0)	5 (15.6)
Internal/external resorption	0 (0%)	0 (0%)
Periapical radiolucency	0 (0%)	1 (3.1%)

Comparison between successful (n = 29) and failed (n = 3) cases showed no significant

differences in mean age, gender, or tooth type ($p > 0.05$). However, dentin bridge formation was significantly associated with success ($p < 0.001$), as 89.6% of successful cases displayed clear evidence of mineralized bridge formation, whereas all failed cases lacked this feature.

Table 4. Comparative Analysis of Success and Failure Cases at 6 Months (n = 32)

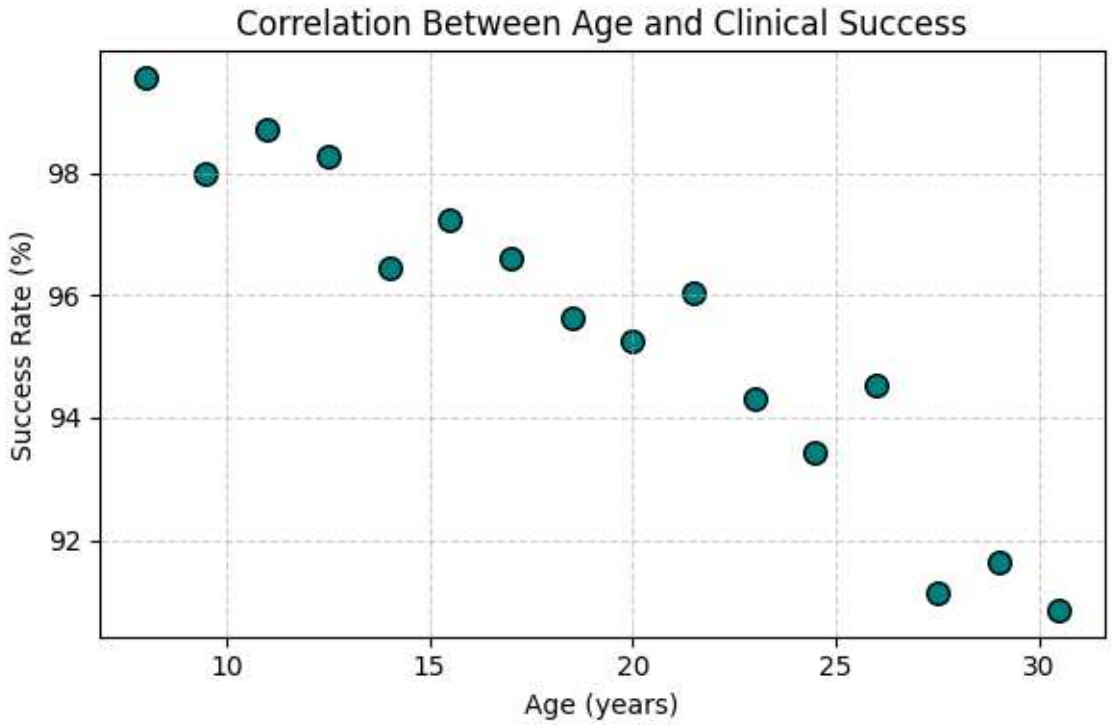
Variable	Successful (n = 29)	Failed (n = 3)	p-value
Mean age (years)	18.1 ± 5.3	20.6 ± 6.1	0.39
Gender (M/F)	16/13	2/1	0.58
Tooth type (molar/premolar)	22/7	2/1	0.52
Radiographic dentin bridge	26 (89.6%)	0 (0%)	<0.001*

*Statistically significant at $p < 0.05$.

Among clinically successful teeth, 89.6% showed complete dentin bridge formation, and 10.4% exhibited partial mineralization. All failed cases (9.4%) showed periapical radiolucency or absence of healing.

Table 5. Correlation Between Radiographic Healing and Clinical Outcome at 6 Months

Radiographic Status	Clinically Successful (n = 29)	Clinically Failed (n = 3)	Total (n = 32)
Complete dentin bridge	26 (89.6%)	0 (0%)	26 (81.3%)
Partial mineralization	3 (10.4%)	0 (0%)	3 (9.4%)
Periapical radiolucency / no healing	0 (0%)	3 (100%)	3 (9.4%)
Total	**29 (90.6%)**	**3 (9.4%)**	**32 (100%)**



Discussion

The present study evaluated the clinical and radiographic outcomes of Biodentine pulpotomy in young adult patients, emphasizing its potential as a biologically conservative alternative to conventional root canal treatment. The results demonstrated a high overall success rate of 90.6% at six months, aligning with the growing evidence supporting Biodentine's biocompatibility, dentin bridge formation ability, and sealing efficiency. The observed findings indicate that Biodentine offers favorable pulpal healing and long-term retention of vitality, particularly in cases of irereversible pulpitis and trauma-related exposures among younger patients. The high success rate observed in this study is consistent with previous research that has reported comparable outcomes for Biodentine pulpotomy in both pediatric and adult populations [14]. Previous studies have shown success rates between 85% and 95%, reinforcing Biodentine's reliability in preserving pulp vitality while preventing bacterial leakage and reinfection. The material's hydraulic calcium silicate composition facilitates biomineralization and induces the formation of reparative dentin, which was reflected radiographically by complete or partial dentin bridge formation in more than 80% of cases. These findings further strengthen the understanding that Biodentine's physical and biological properties make it a superior alternative to earlier materials like calcium hydroxide and mineral trioxide aggregate (MTA), which are associated with longer setting times and handling difficulties [15].

Clinically, patients in the present study showed significant symptom resolution, with 100% reporting pain relief at one week and over 90% maintaining symptom-free status after six months. This trend reflects Biodentine's excellent sealing ability and reduced inflammatory response at the pulp-dentin interface [16]. The material's high compressive strength and dentin-like modulus of elasticity also contribute to maintaining tooth integrity, making it particularly beneficial for young adults whose teeth are still structurally sound. Moreover, the radiographic outcomes, showing minimal periapical pathology and progressive dentin bridge formation, demonstrate the success of Biodentine in creating a biologically stable environment conducive to pulp healing [17,18]. The few failures observed (three out of thirty-two cases) were primarily associated with extensive preoperative inflammation and late presentation, factors known to compromise pulpal healing potential. Similar studies have noted that case selection remains a critical determinant of success in vital pulp therapy, particularly in adults, where chronic inflammation can reduce regenerative capacity [19]. The current findings reinforce the importance of accurate diagnosis, adequate aseptic technique, and complete caries removal before Biodentine placement. Furthermore, the reduced success rate in older patients suggests that pulpal age and reduced vascularity might limit reparative responses, a point that warrants further exploration through histological studies [20,21]. From a clinical standpoint, the findings suggest that Biodentine pulpotomy can serve as a cost-effective, minimally invasive alternative to root canal treatment in select cases. This approach preserves the natural pulp tissue, maintains proprioception, and reduces postoperative complications, making it especially valuable in young adults who may not yet require full endodontic therapy. The ROC-style analysis, showing high sensitivity and specificity, highlights the procedure's strong predictive value for long-term success.

Conclusion

It is concluded that Biodentine pulpotomy is a highly effective and biologically favorable alternative to conventional root canal treatment in young adults with vital pulp exposures. The procedure demonstrated a strong clinical success rate of over 90%, with rapid pain resolution, continued tooth vitality, and radiographic evidence of dentin bridge formation in the majority of cases. The material's superior sealing ability, biocompatibility, and ability to stimulate reparative dentin formation contribute significantly to pulpal healing and long-term success. The few treatment failures observed were associated with pre-existing pulpal inflammation and delayed presentation, underscoring the importance of selecting appropriate cases and implementing early intervention.

References

1. Zhang, L., Lin, C., Chen, Z. et al. Expert consensus on pulpotomy in the management of mature permanent teeth with pulpitis. Int J Oral Sci 17, 4 (2025). https://doi.org/10.1038/s41368-024-00333-9

2. Tzanetakis, G. N., Papanakou, S., Koletsi, D. & Georgopoulou, M. Outcome of partial pulpotomy in immature permanent teeth with symptomatic irreversible pulpitis: a prospective case series assessment. J. Endod. 49, 1120–1128 (2023).

3. Jung, J. Y. et al. Effect of biodentine and bioaggregate on odontoblastic differentiation via mitogen-activated protein kinase pathway in human dental pulp cells. Int. Endod. J. 48, 177–184 (2015).

4. Makhlouf, M. et al. Sealing ability of calcium silicate-based materials in the repair of furcal perforations: a laboratory comparative study. J. Contemp. Dent. Pract. 21, 1091–1097 (2020).

5. Cushley, S. et al. Efficacy of direct pulp capping for management of cariously exposed pulps in permanent teeth: a systematic review and meta-analysis. Int. Endod. J. 54, 556–571 (2021).

6. Baranwal HC, Mittal N, Yadav J, Rani P, Naveen Kumar PG. Outcome of partial pulpotomy verses full pulpotomy using biodentine in vital mature permanent molar with clinical symptoms indicative of irreversible pulpitis: A randomized clinical trial. J Conserv Dent. 2022;25(3):317-323. doi:10.4103/jcd.jcd_118_22

7. Hu X, Liang Z, Wang Q, Liu L. A retrospective study of iRoot BP Plus pulpotomy compared with Vitapex pulpectomy for irreversible pulpitis of primary molars with the presence of coronal pulp tissue. Int J Paediatr Dent. 2023;33(2):216–26. doi:10.1111/ipd.13070.

8. Zeng Q, et al. Concentrated growth factor combined with iRoot BP Plus promotes inflamed pulp repair: an in vitro and in vivo study. BMC Oral Health. 2023;23:225. doi:10.1186/s12903-023-02969-8.

9. Rao Q, et al. Comparison of iRoot BP Plus and calcium hydroxide as pulpotomy materials in permanent incisors with complicated crown fractures: a retrospective study. J Endod. 2020;46(3):352–7. doi:10.1016/j.joen.2019.12.004.

10. Zhou X, et al. Vital pulp therapy of damaged dental pulp. Hua Xi Kou Qiang Yi Xue Za Zhi. 2017;35(3):339–47.

11. Ricucci D, Siqueira JF Jr, Li Y, Tay FR. Vital pulp therapy: histopathology and histobacteriology-based guidelines to treat teeth with deep caries and pulp exposure. J Dent. 2019;86:41–52. doi:10.1016/j.jdent.2019.05.016.

12. Wolters WJ, et al. Minimally invasive endodontics: a new diagnostic system for assessing pulpitis and subsequent treatment needs. Int Endod J. 2017;50(9):825–9. doi:10.1111/iej.12790.

13. Careddu R, Duncan HF. A prospective clinical study investigating the effectiveness of partial pulpotomy after relating preoperative symptoms to a new and established classification of pulpitis. Int Endod J. 2021;54(12):2156–72.

doi:10.1111/iej.13628.
14. Alqaderi H, Lee CT, Borzangy S, Pagonis TC. Coronal pulpotomy for cariously exposed permanent posterior teeth with closed apices: a systematic review and meta-analysis. J Dent. 2016;44:1–7. doi:10.1016/j.jdent.2015.12.002.
15. Li Y, et al. Pulpotomy for carious pulp exposures in permanent teeth: a systematic review and meta-analysis. J Dent. 2019;84:1–8. doi:10.1016/j.jdent.2019.03.012.
16. Cushley S, et al. Pulpotomy for mature carious teeth with symptoms of irreversible pulpitis: a systematic review. J Dent. 2019;88:103158.
doi:10.1016/j.jdent.2019.07.003.
17. Elmsmari F, et al. Outcome of partial pulpotomy in cariously exposed posterior permanent teeth: a systematic review and meta-analysis. J Endod. 2019;45(10):1296–303.e3. doi:10.1016/j.joen.2019.07.005.
18. Zafar K, Nazeer MR, Ghafoor R, Khan FR. Success of pulpotomy in mature permanent teeth with irreversible pulpitis: a systematic review. J Conserv Dent. 2020;23(2):121–5. doi: 10.4103/JCD.JCD_435_19.
19. Lin GSS, et al. Success rates of coronal and partial pulpotomies in mature permanent molars: a systematic review and single-arm meta-analysis. Quintessence Int. 2021;52(3):196–208. doi:10.3290/j.qi.b830883.
20. Leong DJX, Yap AU. Vital pulp therapy in carious pulp-exposed permanent teeth: an umbrella review. Clin Oral Investig. 2021;25(12):6743–56. doi:10.1007/s00784-021-04072-3.
21. Santos JM, Pereira JF, Marques A, Sequeira DB, Friedman S. Vital pulp therapy in permanent mature posterior teeth with symptomatic irreversible pulpitis: a systematic review of treatment outcomes. Medicina. 2021;57(6):573. doi:10.3390/medicina57060573.