To Compare Mineral Trioxide Aggregate, Platelet-rich Fibrin, and Calcium Hydroxide in Teeth with Irreversible Pulpitis: A Clinical Study

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Aim: Numerous pulp-capping agents such as mineral trioxide aggregate (MTA), calcium hydroxide (Ca(OH)2), platelet-rich fibrin (PRF), and biodentine have been suggested. This clinical study was conducted to compare MTA, PRF, and Ca(OH)2 in teeth with irreversible pulpitis. Materials and Methods: The 60 mandibular molar teeth with irreversible pulpitis were used in this study, which were restored with Ca(OH)2, MTA, and PRF. Assessments of the treatment were carried out at 6 months and 1 year by clinical examination and also radiographically. Results: A nonsignificant difference was observed in pain intensity recorded at numerical rating scale at baseline, 24 h, 1 week, 1 month, 3 months, 6 months, and 1 year. A nonsignificant \( P > 0.05 \) difference was reported in clinical and radiographic success rate recorded at 6 months and 1 year in all groups. Conclusion: Pulp-capping agents such as Ca(OH)2, MTA, and PRF yielded similar success rate when used in teeth with irreversible pulpitis.

KEYWORDS: Mineral trioxide aggregate, platelet-rich fibrin, pulp capping

INTRODUCTION

Pulpitis is a common disease of the tooth, characterized by severe pain for which patients seek immediate treatment. Pulpitis can be acute or chronic depending on the duration of pain. Reversible and irreversible pulpitis can be managed with different treatment modalities. Complete pulpectomy, that is, complete removal of pulp, is a commonly used treatment technique for irreversible pulpitis in permanent teeth.\(^1\)

In case of irreversible pulpitis in mature teeth with complete root formation, pulpotomy should be recommended instead to pulpectomy as there are chances of infection-free tooth to heal. Moreover with
pulpectomy, the survival time of the tooth decreases significantly as compared to natural tooth.\textsuperscript{[3]}

Teeth with pulpectomy or pulpotomy procedure should be capable of bearing occlusal overload and function properly without getting fractured. Qudeimat et al.\textsuperscript{[3]} in their study suggested that young permanent teeth with incomplete closure of root should be managed with pulpotomy and later on restored with mineral trioxide aggregate (MTA). This procedure is sufficient to allow tooth to complete its root formation and to function in the oral cavity for longer period.\textsuperscript{[3]}

Commonly used pulp-capping agents, such as calcium hydroxide (\textit{Ca(OH)}\textsubscript{2}), biodentine, and MTA, have been suggested. \textit{Ca(OH)}\textsubscript{2} has disadvantages such as dissolution over time and poor dentin adherence. In other side, MTA is preferred over \textit{Ca(OH)}\textsubscript{2} because there is faster dentin bridge formation, which allows better pulp healing. It also possesses properties such as biocompatibility, antibacterial nature, good stability, and excellent sealing ability.\textsuperscript{[4]}

Other material of choice is platelet-rich fibrin (PRF), which is also biocompatible, induces pulpal healing by moderating pulpal inflammation by liberating cytokines such as interleukin (IL)-4.\textsuperscript{[5]} Taking these things into consideration, this study was conducted to compare MTA, PRF, and \textit{Ca(OH)}\textsubscript{2} in teeth with irreversible pulpitis.

**Materials and Methods**

The patients visiting department of endodontics were informed about the study and after having obtained written consent, 60 mandibular molar teeth of both the genders were included in the study. Ethical clearance was obtained from ethics committee of the institution.

Relevant patient data such as name, age, and gender were recorded. In all patients, endodontic procedure was performed following all standardized procedure by a single endodontist. Intraoral radiographs were obtained with digital radiographs taken with paralleling technique. A 2\% lignocaine containing 1:80,000 adrenaline was used for anesthetizing the nerve through nerve block. Following this, caries were cleared with a sterile round diamond bur to help in the preparation of access cavity. Throughout the procedure, copious irrigation was done to remove coronal pulp till the level of orifices with the bur. After careful irrigation, bleeding was arrested with sterile saline solution. Depending on the pulpotomy agent used, the three groups were charted, where Group 1 patients were treated with \textit{Ca(OH)}\textsubscript{2}, Group II with MTA, and Group III with PRF.

Patients were recalled regularly after 24 h, 1 week, 3 months, 6 months, and 1 year. Pain intensity was recorded at each visit. Assessments of the treatment were carried out at 6 months and 1 year by clinical examination and also radiographically. The presence of abscess, swelling, sinus tract, and tenderness denoted clinical failure. Radiographic evidence of periodontal widening suggested failure of treatment. Obtained results were then tabulated, and statistics tests for the same were done. \textit{P} value less than 0.05 was deemed as statistically significant when analyzed by Kruskal–Wallis test.

**Results**

The type of material and the number of patients included in the study are present in Table 1. It can be seen that there was a nonsignificant difference in the pain intensity recorded at numerical rating scale at baseline, 24 h, 1 week, 1 month, 3 months, 6 months, and 1 year [Table 2, Graph 1].

Table 3 shows that clinical success rate in Group I, Group II, and Group III was 81.5\%, 82.4\%, and 83.8\% at 6 months, respectively. Clinical success rate at 1 year in Group I, Group II, and Group III was 81.2\%, 82.1\%, 83.8\%.

| Groups | Group I | Group II | Group III | P value |
|--------|---------|----------|-----------|---------|
| Materials | \textit{Ca(OH)}\textsubscript{2} | MTA | PRF | |
| Number | 20 | 20 | 20 | |

**Table 1: Distribution of teeth**

| Time       | Group I | Group II | Group III | \textit{P} value |
|------------|---------|----------|-----------|-----------------|
| Baseline   | 6.23    | 6.15     | 6.28      | 0.512           |
| 24 h       | 1.2     | 1.4      | 1.1       | 0.672           |
| 1 week     | 0.54    | 0.62     | 0.52      | 0.125           |
| 1 month    | 0.67    | 0.68     | 0.54      | 0.436           |
| 3 months   | 0.65    | 0.61     | 0.60      | 0.329           |
| 6 months   | 0.45    | 0.42     | 0.51      | 0.321           |
| 1 year     | 0.41    | 0.40     | 0.38      | 0.416           |

Kruskal–Wallis test, significant at \textit{P} < 0.05
and 82.4%, respectively. *P* value was greater than 0.05, hence nonsignificant.

Radiographic success rate at 6 months was 82.3%, 83.4%, and 84.2% in Group I, II, and III, respectively [Graph 2], whereas at 1 year, it was 81.5%, 92.3%, and 84.1% in Group I, II, and III, respectively, which was nonsignificant as *P* > 0.05.

**DISCUSSION**

Pulp-capping agents are used to maintain the vitality of pulp exposed due to iatrogenic errors or trauma with vital pulp therapy. It has been observed that in deep carious lesions, inflammation is limited to superficial pulp, whereas tissue deep inside the pulp remains normal to large extent with an exception of some dilated blood vessels. Thus, pulp healing can occur even after a carious exposure if less severe inflammation is seen such as in reversible pulpitis. Endodontic approach through root canal therapy is a widely used method in case of pulpal exposure during caries excavation. The insertion of medicaments against cariously exposed pulp is contentious.

MTA provide favorable results when used as direct pulp-capping agents in mechanically exposed pulps. The final healing of pulp can be judged by its ability to form dentin bridge, and it protects the exposed pulp from the further attack of oral bacteria that may result in pulp degeneration, atrophy, and shrinkage. PRF, being autologous, is more biocompatible and less severe on pulp. Its use in pulp capping is increasing as it is providing favorable results. This study was conducted to compare MTA, PRF, and Ca(OH)₂ in teeth with irreversible pulpitis.

In this study, we included mandibular molars in which pulpotomy was performed, and teeth were restored with agents such as Ca(OH)₂, in Group I, MTA in Group II, and PRF in Group III, as these are commonly used pulp-capping agents.

We found that pain score in all groups recorded after 24 h, 1 day, 7 days, 1 month, 3 months, 6 months, and 12 months was more in Group I as compared to that in Group I and Group III. However, nonsignificant results were found between the groups. Kumar *et al.* in their study included 54 molar teeth, which were divided into three groups of 18 each. Group I teeth were restored with CH, Group II with MTA, and Group III with PRF as pulpotomy agents, which revealed nonsignificant difference in pain score recorded regularly on recalled visits. Similarly, the clinical success and radiographic success rate was also nonsignificant between the groups (*P* > 0.05).

We observed that the clinical success rate in Groups I, II, and III was 81.5%, 82.4%, and 83.8% at 6 months, respectively. At 1 year, it was 81.2%, 82.1%, and 82.4% in Groups I, II, and III, respectively. A study conducted to check the clinical response of pulp–dentin complex by Hegde *et al.*, included 24 permanent molars with carious exposure and they performed pulp capping with MTA and biodentine. They divided patients into two groups, MTA was used in Group I, and Group II was treated with biodentine. Clinical and radiographic evaluation was done at 3 weeks, 3 months, and 6 months. MTA and biodentine showed 91.7% and 83.3% success rate, respectively, over a period of 6 months.

We found that radiographic success rate in Groups I, II, and III was 82.3%, 83.4%, and 84.2% at 6 months,
respectively, whereas it was 81.5%, 92.3%, and 84.1% in Groups I, II, and III, respectively. In a study conducted in 407 patients by Asgary et al.,[10] the patients were divided into two treatment groups randomly, Group 1 received (vital pulp therapy/calcium-enriched mixture) and Group 2 was treated by root canal therapy. After 5 years, the assessment results revealed no significant differences in the successes in both groups. The patients’ age or gender did not have any significant outcome on the result, and also the presence of periapical lesion preoperatively did not bear any significant effect on both the groups ($P > 0.05$).

A study conducted by Marques et al.[11] to assess the treatment outcome using MTA in 64 teeth, recalled after 3.6 years, showed success rate of 91.3%. The occlusal caries had 100% success rate, whereas the proximal caries had 89.7% success rate. In initial caries, a success rate of 94.7% was seen, whereas in secondary caries, it was 88.9%, and in patients younger than 40 years, the success rate was 100%, whereas in patients older than 40 years, it was 80%.

**CONCLUSION**

It has been evident that the success rate was similar when Ca(OH)$_2$, MTA, and PRF were used for pulp capping in teeth with irreversible pulpitis.

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**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Margunato S, Taşlı PN, Aydn S, Karapınar Kazandağ M, Şahin F. *In vitro* evaluation of proroot MTA, biodentine, and MM-MTA on human alveolar bone marrow stem cells in terms of biocompatibility and mineralization. J Endod 2015;41:1646-52.
2. Zhu C, Ju B, Ni R. Clinical outcome of direct pulp capping with MTA or calcium hydroxide: a systematic review and meta-analysis. Int J Clin Exp Med 2015;8:17055-60.
3. Qudeimat MA, Alyahya A, Hasan AA. Mineral trioxide aggregate pulpotomy for permanent molars with clinical signs indicative of irreversible pulpitis: a preliminary study. Int Endod J 2017;50:126-34.
4. Lipski M, Nowicka A, Kot K, Postek-Stefańska L, Wysoczańska-Jankowicz I, Borkowski L, *et al.* Factors affecting the outcomes of direct pulp capping using biodentine. Clin Oral Investig 2018;22:2019-9.
5. Peng C, Zhao Y, Yang Y, Qin M. Mineral trioxide aggregate pulpotomy for the treatment of immature permanent teeth with irreversible pulpitis: a preliminary clinical study. Zhonghua Kou Qiang Yi Xue Za Zhi 2015;50:715-9.
6. Vallés M, Roig M, Duran-Sindreu F, Martínez S, Mercadé M. Color stability of teeth restored with biodentine: a 6-month *in vitro* study. J Endod 2015;41:1157-60.
7. Taha NA, Ahmad MB, Ghanim A. Assessment of mineral trioxide aggregate pulpotomy in mature permanent teeth with carious exposures. Int Endod J 2017;50:117-25.
8. Kumar V, Juneja R, Duhan J, Sangwan P, Tewari S. Comparative evaluation of platelet-rich fibrin, mineral trioxide aggregate, and calcium hydroxide as pulpotomy agents in permanent molars with irreversible pulpitis: a randomized controlled trial. Contemp Clin Dent 2016;7:512-8.
9. Hegde S, Sowmya B, Mathew S, Bhandi SH, Nagaraja S, Dinesh K. Clinical evaluation of mineral trioxide aggregate and biodentine as direct pulp capping agents in carious teeth. J Conserv Dent 2017;20:91-5.
10. Asgary S, Eghbal MJ, Fazlyab M, Baghban AA, Ghoddusi J. Five-year results of vital pulp therapy in permanent molars with irreversible pulpitis: a non-inferiority multicenter randomized clinical trial. Clin Oral Investig 2015;19:335-41.
11. Marques MS, Wesselink PR, Shemesh H. Outcome of direct pulp capping with mineral trioxide aggregate: a prospective study. J Endod 2015;41:1026-31.