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RESEARCH ARTICLE
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COMPARISON OF VITAL PULP THERAPY USING MINERAL TRIOXIDE AGGREGATE (MTA) VERSUS ONE-VISIT ROOT CANAL THERAPY ON POSTOPERATIVE PAIN RELIEF IN IRREVERSIBLE PULPITIS AMONG THE PATIENTS REPORTING TO THE MARGALLA DENTAL HOSPITAL, RAWALPINDI

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ABSTRACT

Objective: to compare vital pulp therapy using mineral trioxide aggregate (MTA) versus one-visit root canal therapy on postoperative pain relief in irreversible pulpitis among the patients reporting to the Margalla Dental Hospital, Rawalpindi

Materials and Methods: This cross-sectional study was conducted in the Operative Dentistry Department of Margalla Institute of Health Sciences, Rawalpindi (MIHS) during six months span from January 2024 to August 2024 by random sampling. The estimated sample size was 138 which was calculated from the previous study. Individuals with vital molar tooth (i.e. vitality test was conducted before anesthesia in particular radicular pulp bleeding after coronal pulp amputation was ascertained to be present), or reported with pain indicating irreversible pulpitis (i.e. a history of spontaneous pain lasting for few second to several hours exacerbation of pain by hot and cold fluids confirmed with hot or cold test, and radiating pain), had opted for extraction for pain relief, were between 9 and 50 years old, willing for follow-up visits, and to provide written informed consent were included in the study. While, individuals with moderate or severe marginal periodontitis, non-restorable tooth, fractured tooth, teeth with internal or external root resorption, prominent

radiolucency at the periapical regions, or furcation, root canal calcification, active systemic disease, physical or mental disability, or pregnant or nursing were excluded. The questionnaire or Performa was filled out by the operator to record the pain intensity of the patient. The pain intensity was recorded before the procedure, 24 hours after the procedure, 72 hours after the procedure, and 1 week after the procedure and the data were analyzed by chi-square test was used to compare tooth-related variables and pain-related variables.

Results: This study compared the efficacy of a One-visit root canal and vital pulp therapy using MTA for postoperative pain relief in irreversible pulpitis. In this study, 50 patients were included out of which 11 presented with moderate pain 34 presented with severe pain, and 5 presented with unbearable pain. 25 went through the procedure of one-visit RCT and 25 went through vital pulp therapy. All patients were contacted after 24 hours to inquire about pain intensity among 25 patients who underwent one visit root canal 2 had no pain, 10 had mild pain, and 13 had moderate pain. And people who underwent VPT with MTA 2 had no pain, 22 had mild pain, and 1 had moderate pain. After that patients were contacted after 72 hours patients with one visit RCT 13 had no pain and 12 had mild pain. Patient with VPT with MTA 18 had no pain and 7 had mild pain. After one week all patients had no pain. Both procedures were effective in alleviating pain after one week but VPT with MTA showed an earlier response in alleviating pain.

Conclusion: In management of irreversible pulpitis vital pulp therapy is more effective alternative as compare to RCT.

Key words: Irreversible pulpitis, Mineral Trioxide Aggregate (MTA), postoperative pain relief, root canal therapy, Vital Pulp Therapy

INTRODUCTION

Irreversible pulpitis is the severe, persistent, and diffuse pain that is a challenge to endodontic therapy. (1) It is done by the abolition of pain and the preservation of the functioning tooth. Traditionally, RCT has been the definitive treatment of irreversible pulpitis, where the inflamed pulp is eliminated to prevent further infection. RCT has an excellent prognosis as it records a success rate of approximately 98%. However, RCT can be time-consuming, expensive, severe to the vascularity of the tooth, and can make the tooth more brittle which can be fractured easily. (2) RCT is more expensive than extraction therefore countries where financial constraints are a problem people usually opt for extraction. (3)

Vital pulp therapy (VPT) appears as a very conservative alternative that must preserve the vitality of the pulp by promoting healing and regeneration of the inflamed tissue. It is also cost-effective compared with conventional RCT. (4) Also, it is used in vital pulp therapy. On the other hand, MTA-based VPT has been a very promising treatment alternative in terms of reducing postoperative pain and promoting long-term tooth survival by allowing physiologic growth of the tooth, challenging the traditional reliance on RCT. (5)

Based on the amount of pulp removed, VPT for irreversible pulpitis with carious exposure can be divided into direct pulp capping, partial pulpotomy, and full pulpotomy. In DPC, the direct application of the pulp capping agent covers the exposed pulp. (6) In the treatment of pulp exposures, the preservation of the whole or at least the radicular part of the dental pulp is critical, more so in carious exposures in young permanent teeth and the complex root canal systems in primary molars. These exposures can be due to caries, iatrogenic mishaps, or traumatic injury. Pulpotomy is a popular treatment in paedodontics, with well-documented positive results regarding its outcome. There is a very clear line of differentiation that segregates the applications of VPT as a treatment approach to immature or mature teeth diagnosed with irreversible pulpitis. Whereas this is almost an accepted treatment for the former, in the latter, the evidence supporting this treatment remains very scant and under discussion for it to be considered as a possible alternative to conventional RCT. (7) Ideally, the

material should have non-toxic, antibacterial, anti-inflammatory, and good sealing properties and should have the ability to induce dentin mineralization. (5)

One of a study compares the effectiveness of VPT using MTA versus one-visit RCT in terms of postoperative pain relief in patients with irreversible pulpitis. In the evaluation of the pain outcomes, it will try to prove that VPT with MTA can be an easy alternative to the more invasive RCT, hence changing treatment paradigms toward more conservative and patient-friendly approaches. The findings may have significant implications for clinical practice by possibly influencing decision-making processes at each stage and thus helping in the enhancement of patient care in endodontics. (8)

In a study by Saeed Asgary et al. 2021, the investigators drew a comparison of the effects of root canal therapy and full pulpotomy by two endodontic biomaterials—mineral trioxide aggregate, MTA, and calcium-enriched mixture, CEM, cement—in mature permanent teeth with carious pulp exposure, including the cases of irreversible pulpitis. Traditionally, this has been treated using RCT, which is a complicated treatment with the history of weakening the teeth structure. VPT seeks the preservation of healthy pulp tissue, with very promising results accruing from the aid of development in biomaterials such as MTA and CEM. MTA, which was discovered in the early 1990s, is widely recognized for its ability to seal due to its biocompatibility. CEM, on the other hand, has improved handling properties and a reduced setting time. In a randomized controlled trial conducted by Asgary et al. in 2021, there were no significant differences in the success rates of RCT and MTA pulpotomy and CEM pulpotomy both clinically and radiographically after two years, which indicates that VPT can be as effective as RCT. These findings justify less invasive VPT as a first-line intervention for carious pulp exposure, with preservation of tooth structure and reduced complexity of procedures. Therefore, it encourages further research in these modern biomaterials for their clinical adoption. (9)

The article by Louis M. Lin et al. (2019) describes vital pulp therapy in mature permanent teeth with irreversible pulpitis in the light of pulp biology and questions classic endodontic treatment modalities. Traditionally, the American Association of Endodontists recommended pulpectomy and root canal filling for teeth diagnosed with irreversible pulpitis, guided by the dictum that inflamed pulp tissue cannot heal. However, histological studies have now shown that in many cases, irreversible pulpitis does not involve the whole pulp, and therefore some parts of the pulp may still be preserved. Indeed, an editorial in the International Endodontic Journal went as far as to say that clinical diagnoses of pulp disease should be re-evaluated as there is often little relationship between the clinical symptoms, the pulp sensibility testing, and the actual histological state of the pulp. Lin et al. conducted a review that takes into consideration the evidence found in the literature about several studies and that shows that VPT can become a predictable treatment for mature permanent teeth with irreversible pulpitis when done correctly and when the diagnosis is accurate. The narrative review calls for a revision of clinical symptoms and pulp sensibility tests about histological findings and charts treatment procedures on the effective management of pulp disease in permanent teeth. These findings also favor a less invasive VPT approach that would offer the added advantage of pulp vitality and function preservation, thus aligning with the growing trend towards minimally invasive endodontic practices. (10)

In this multicenter randomized controlled trial, Mohammad Jafar Eghbal et al. compares the postoperative pain after RCT with two pulpotomy medicaments, mineral trioxide aggregate and calcium-enriched mixture, in mature permanent teeth with carious pulp exposure. Traditionally, RCT has been the standard approach in such cases, while this study is investigating less invasive pulpotomy techniques. In this study, 550 cariously exposed pulps were randomly allocated to one of three treatment groups: PMTA, n = 188; PCEM, n = 194; and RCT, n = 168. The Numerical Rating Scale was used to record the pre-operative pain intensity. The post-operative PIs were recorded for seven continuous days. No statistically significant differences in the pre-operative PI among the three groups were observed (P = 0.998). The mean sum of the PIs recorded during the 10 post-operative intervals was similar (P = 0.939). Trends of pain relief were also similar among all study arms, with a P =

0.821. Of note were the high incidences of moderate-to-severe preoperative pain: 56.5% for RCT, 55.7% for PMTA, and 56.7% for PCEM; however, these reduced significantly after 24 hours to 13.1%, 10.6%, and 12.9%, respectively, with a P = 0.578. Duration of endodontic procedures differed significantly, with RCT taking longer, 69.73 minutes, in comparison to PMTA, which was 35.37 minutes, and PCEM, which was 33.62 minutes, with a P < 0.001. A greater degree of preoperative pain, the presence of symptomatic apical periodontitis, and the widening of the PDL all significantly correlated with an increase in postoperative pain (P=0.002, 0.035, and 0.023, respectively). Conclusively, pulpotomy using MTA/CEM and RCT are considered effective and similar for relief from postoperative pain. This thus substantiates less invasive pulpotomy techniques as viable alternatives to traditional RCT for the treatment of carious pulp exposures in mature teeth. (11)
The objective of the study was to compare vital pulp therapy using mineral trioxide aggregate (MTA) versus one-visit root canal therapy on postoperative pain relief in irreversible pulpitis among the patients reporting to the Margalla Dental Hospital, Rawalpindi.

METHODOLOGY

This cross-sectional study was leveraged by random sampling as a method to compare the efficacy results of two different dental procedures i.e. visit root canal and vital pulp therapy using MTA in providing post-operative pain relief for irreversible pulpitis. We hypothesized that vital pulp therapy with MTA is equal to or in some cases better than one visit root canal therapy in terms of postoperative pain relief. The study was conducted in the Operative Dentistry Department of Margalla Institute of Health Sciences, Rawalpindi (MIHS) after obtaining ethical clearance from the ethical research committee of MIHS during the span of six months span from January 2024 to August 2024. The estimated sample size was 138 which was calculated from the previous study.
Individuals with vital molar tooth (i.e. vitality test was conducted before anesthesia in particular radicular pulp bleeding after coronal pulp amputation was ascertained to be present), or reported with pain indicating irreversible pulpitis (i.e. a history of spontaneous pain lasting for few second to several hours exacerbation of pain by hot and cold fluids confirmed with hot or cold test, and radiating pain), had opted for extraction for pain relief, were between 9 and 50 years old, willing for follow-up visits, and to provide written informed consent were included in the study. While, individuals with moderate or severe marginal periodontitis, non-restorable tooth, fractured tooth, teeth with internal or external root resorption, prominent radiolucency at the periapical regions, or furcation, root canal calcification, active systemic disease, physical or mental disability, or pregnant or nursing were excluded.
Participants of the study were selected from the patients referred to the operative department according to the selection criteria. After getting written consent patients were asked to choose from sealed envelopes concealing the type of interventions. Participants were blinded but the dentist was not blinded. After choosing the envelope the procedure was explained to the participants. A proofread and structured questionnaire was used. The questionnaire or Performa was filled out by the operator to record the pain intensity of the patient. The pain intensity was recorded before the procedure, 24 hours after the procedure, 72 hours after the procedure, and 1 week after the procedure. The data were analyzed using a statistical program for social sciences (SPSS version 25).
The chi-square test was used to compare tooth-related variables and pain-related variables.

RESULTS

This study compared the efficacy of a One-visit root canal and vital pulp therapy using MTA for postoperative pain relief in irreversible pulpitis. 75 patients were selected for the study, of which 10 refused to participate, and 50 met the inclusion criteria. In included participants 54% were male and 46% were female with mean age of 40.98±11.801.
In the current study, tooth numbers were selected based on chief complaints of pain. A total of 30(60.0%) patients were presented with pain of mandibular molars, 11(20.0%) patients were

presented with pain of maxillary molars, 6(12.0%) patients were presented with pain of mandibular molars, and 3(6.0%) patients were presented with the pain of maxillary premolars.

Table 1 Frequencies showing occurrence by tooth name

Tooth name	Frequency	Percentage
mandibular molar	30	60.0
maxillary molar	11	22.0
mandibular premolar	6	12.0
maxillary premolar	3	6.0

In this study, 50 patients were included out of which 11 presented with moderate pain 34 presented with severe pain, and 5 presented with unbearable pain. 25 went through the procedure of one-visit RCT and 25 went through vital pulp therapy. All patients were contacted after 24 hours to inquire about pain intensity among 25 patients who underwent one visit root canal 2 had no pain, 10 had mild pain, and 13 had moderate pain. And people who underwent VPT with MTA 2 had no pain, 22 had mild pain, and 1 had moderate pain. After that patients were contacted after 72 hours patients with one visit RCT 13 had no pain and 12 had mild pain.

Table 2 Intensity of pain by One visit root canal therapy and Vital pulp therapy with MTA

	No pain	Mild pain	Moderate pain	Severe pain	Unbearable pain
Pre-Op					
One visit root canal	-	-	10	13	2
Vital pulp therapy with MTA	-	-	1	21	3
24 HR					
One visit root canal	2	10	13	-	-
Vital pulp therapy with MTA	2	22	1	-	-
72 HR					
One visit root canal	13	12	-	-	-
Vital pulp therapy with MTA	18	7	-	-	-
1 WEEK					
One visit root canal	25	-	-	-	-
Vital pulp therapy with MTA	25	-	-	-	-

Patient with VPT with MTA 18 had no pain and 7 had mild pain. After one week all patients had no pain. Both procedures were effective in alleviating pain after one week but VPT with MTA showed an earlier response in alleviating pain.

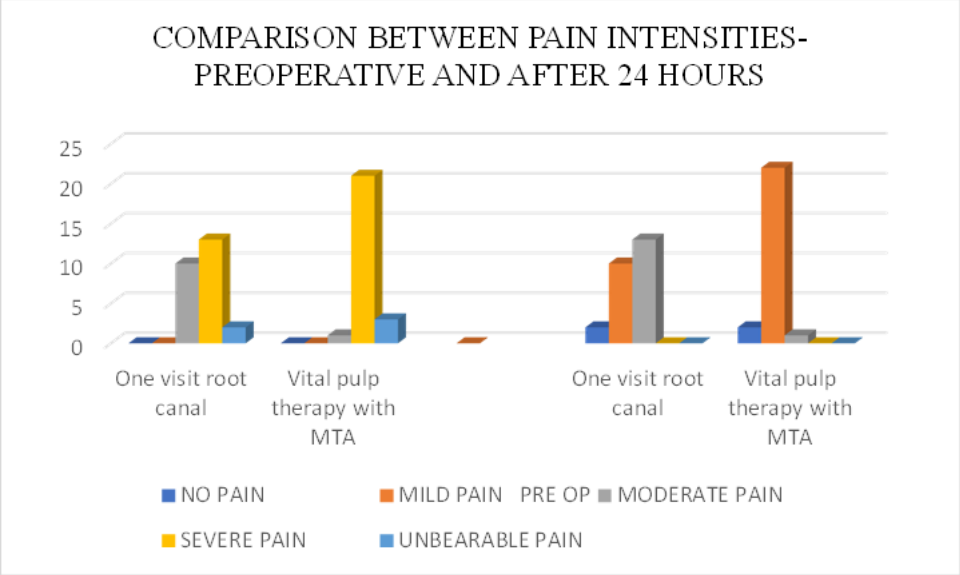

Figure 1 Comparison between pain intensities- preoperative and after 24 hours

The above table compares preoperative and postoperative pain intensities among two procedures: one-visit RCT and VPT with MTA. It shows that VPT with MTA has better outcomes than one-visit RCT. To find an association between two treatments (single visit RCT and VPT with MTA) we applied chi-square keeping p value <0.05 as significant. We have significant difference of 0.001 after 24 hours postoperatively it might be because VPT with MTA responded earlier to alleviate pain as compared to one visit RCT.

Table 3 Association of treatment option with pain intensity

	P value (<0.05)
Pre operative	.009
24 hours	.001
72 hours	.145

DISCUSSION

In this study, a comparison was done between vital pulp therapy with MTA and one-visit RCT for post operative pain relief in irreversible pulpitis. Regarding the association between the treatments mentioned above, the results were significant after 24 hours and insignificant after 72 hours. Patients age was an important factor to judge the prognosis of the pulpotomy (12)In our study tooth was selected based on the chief complaint. More mandibular molar was presented with pain as compared to the other teeth.

According to one of the previous studies, it has been noted that vital pulp therapy is more effective in pain control as compared to RCT and MTA is more effective in pain alleviation as compared to calcium-enriched material. This point is found to be in coherence with our literature. (8) . In another previous study, patients who underwent pulpotomy had better pain alleviation than RCT. Pain relief was achieved in a shorter time with pulpotomy as compared to RCT. Patients were more satisfied with pulpotomy as compare to RCT because it was inexpensive, had less intraoperative pain, and less time taking. Which is in coherence with our study. Bio-dentine was used in pulpotomy in a previous study on the contrary MTA was used in our study (13). In a randomized clinical trial, the effect of pulpotomy with two biomedical materials, i.e., MTA and CEM, was studied for pain relief as an alternate treatment modality compared to RCT in managing carious exposed pulp in symptomatic/asymptomatic mature molar. In addition, rotary instrumentation was done. These new treatment modalities i.e. pulpotomy with MTA and CEM are highly effective as well as RCT. The

study revealed that there is no significant difference in these three modalities in pain relief. On the contrary, our study revealed that VPT with MTA had earlier better results (11). In another study, two study arms were used: one-visit RCT and VPT/CEM. Both treatments had clinically the same results. On the other hand, in our study, we had better results with VPT with MTA. However, the treatment time span was greater with RCT. Radiographically, VPT/CEM had better results with no statistical difference. In our study, the results were not assessed radiographically (14).

A previous report shows that there was no significant difference in these procedures in terms of pain intensity(9). Furthermore, it is proposed recently that the treatment is cost-effective. Pulpotomy can be a substitute for root canal treatment in managing permanent teeth with carious exposure or even with irreversible pulpitis because of its cost-effectiveness(15). Moreover, MTA is highly biocompatible. A recent study shows that all type of MTA shows biocompatibility and biomineralization. (16) In the prospective cohort study, Xiaoxu Guan et al. (2021) the success rate was 90.5% after one year or more, and no preoperative symptoms or physical examination findings significantly influenced the prognosis of VPT. These results suggest that VPT using iRoot BP Plus is a viable and effective treatment for the management of irreversible pulpitis in young patients and supports the shift toward preserving pulp vitality and function in permanent teeth. While in this study, we found out that MTA had better outcomes as compared to that of one visit RCT. (17)

Moreover, in this research sample size was very limited. We did not consider socio-economic status of the patients which can effect dental pain(18). No other material was used. Setting time of MTA is long(19). Pulpotomy has different side effects.

CONCLUSION

In management of irreversible pulpitis vital pulp therapy is more effective alternative as compare to RCT.

Disclaimer

None

Conflict of Interest

No conflict of interest to be declared

Ethical statement

Ethical letter in which approval of this study was obtained has been attached along.

Funding Disclosure

Nil

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