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ORIGINAL ARTICLE

Clinical outcome of direct pulp capping by using mineral trioxide aggregate and calcium hydroxide in the mature permanent teeth during the carious tissue removal.

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ABSTRACT… Objective: To compare the clinical outcome in between the mineral trioxide aggregate (MTA) and calcium hydroxide (CaOH) during the direct pulp capping in mature permanent teeth. **Study Design:** Comparative Cross Sectional. **Setting:** Department of Operative Dentistry and Endodontics, Institute of Dentistry, Liaquat University of Medical & Health Sciences Jamshoro / Hyderabad. **Period:** January 2022 to December 2022. **Material & Methods:** We included all patients who had vital pulp, reversible pulpitis, mature teeth with closed apex, and were between the ages of 18 and 35, regardless of gender. Two groups of patients with equal numbers were formed. Those in groups A and B. Patients in Group A received MTA treatment, whereas those in Group B received CaOH treatment. Patients in both groups were encouraged to follow up to check on the discomfort and sensitivity of the tooth after 24 hours, a week, three months and six months. Data were gathered using a research proforma. **Results:** The mean age of the patients was 27.13+4.59 years in CaOH group and 27.43+4.40 years in MTA group. Pre- operatively the most of the patients had moderate to severe pain in both groups as 40.0% and 46.7% in CaOH group and 20.0% and 80.0% in MTA group respectively. Severity of the post-operative pain was less in MTA group while findings were statistically insignificant (p-0.143). On the pain assessment after 3 months, only 13.3% cases had mild pain in CaOH group, while no any case found with pain in MTA group (p-0.038). Post operative pain on7th month was almost decreased complete in both groups. Test validity was positive in all of the cases till 6th months follow-up, which indicted that no nay cases had developed narcosis after treatment in both groups. Furthermore, in this study, there was no any cases found with radiological abnormalities during follow-up of 24 hours to 6 month post-operatively in both groups. **Conclusion:** After direct pulp capping in adult permanent teeth, both mineral trioxide aggregate and calcium hydroxide were demonstrated to be effective. However, MTA seems to be more effective than calcium hydroxide in preserving long-term pulp vitality.

Key words: CaOH, Direct Pulp Capping, MTA, Pain.

INTRODUCTION

Direct capping of the pulp is a technique in which a limited area of the vital pulp is exposed and is immediately covered by the protective foundation or dressing. Direct Capping of the pulp has two goals: to keep the tooth healthy and to make the development of the reparative dentine easier. This surgery is carried out in order to shield the tooth from needing root canal therapy (RCT).[1]

The patient's age has a very clear effect with the higher rate of success in young patients. Direct Pulp Capping is the procedure that is performed with Calcium Hydroxide (CaOH) and it is described as most common method to treat the carious exposure in adolescent patients.[2]

Calcium Hydroxide (CaOH) also has few drawbacks, like the presence of tunnels in dentine bridges, excessive dentine formation that destroys the pulp chamber, highly dissolvable in oral fluids, insufficient adherence and Next to the acid etching that has few restrictions reported with calcium hydroxide (CaOH). So because

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of these drawbacks of calcium hydroxide other materials has put forward for direct pulp capping Like mineral trioxide aggregate (MTA).[3]

Several pulp capping materials are obtainable for direct pulp capping. calcium hydroxide has a state the governing material for many years but newly Mineral trioxide aggregate has shown as the best material for pulp capping Because its compatible, non-mutagenic cement with better sealing ability.[4]

Mineral trioxide aggregate consists of the calcium oxide in the configuration of tricalcium Silicate, dicalcium silicate, tricalcium aluminate and bismith oxide for radiopaque. Calcium hydroxide is the principal responsive result of mineral trioxide aggregate and water. That is biocompatible because of the CaOH formation which triggers the pulp healing.[6]

The drawbacks of MTA are: costly, that causes the teeth staining time and difficult to handle. CaOH is broadly obtained as material of choice for DPC although the clinical success rate differs significantly from 13% upto 97.8%. Nearer examination of the clinical data, DPC with CaOH or its combination disclose the success rate refuses as the check out success rate. MTA has set off additionally popular as another option for the vital pulp therapy and because of its standard it is now considered as the best material of choice.[5]

CaOH has been observed the good quality of DPC material for the prolonged interval while the recent cement has considered the favorable substitute. CaOH has anti bacterial properties to reduce or get rid of the bacterial invasion and later annoyance of pulpal tissue.[6]

This study aims is to evaluate the clinical outcome of direct pulp capping using the MTA and CaOH as there is limited local data available on this topic in our society so this study will be beneficial for patients as we will be able to recommend the more biocompatible material for Direct Pulp Capping.

MATERIAL & METHODS

After receiving clearance from LUMHS Jamshoro's research ethics committee (LUMHS/REC/238: 14-12-2021), this study was carried out from January to December 2022. Following computation using the Open Epi sample size calculator method, 30 patients in total were recruited in each group. Each research participant was given a thorough description of the study at the time of recruitment, and both verbal and written informed permission was acquired from every participant.

Patients having age range of 18 to 35 with vital pulp, reversible pulpitis and mature tooth with close apex were enrolled in the study. While subjects non vital tooth, primary tooth with open apex, irreversible pulpitis, necrotic pulp, cracked tooth and periodontal diseases were excluded from study. Detail history, clinical and radiographical examination were made from the patients in which patients having deep caries approaching to the pulp on the periapical radiograph. Mature permanent teeth exhibiting deep carries approaching to the pulp were chosen for the study. The tooth was isolated with a rubber dam after the injection of local anaesthesia (2% lignocaine hydrochloride with 1:80,000 epinephrine). The tooth was then scrubbed with 2% chlorhexidine to sterilise it. Deep caries were first excavated using a slow-moving handpiece and a round carbide bur, and any residual soft cavities were excavated using a spoon excavator. Following excavation, 2.5% NaHcl was used to sterilise the exposed pulp using a syringe and a cotton pellet. To obtain sufficient pulpal hemostasis, a cotton pellet was inserted into the cavity and left there for 10 minutes. The tooth was cleaned with saline and dried with cotton pellets (if bleeding persisted beyond this, tooth was omitted from research).

The equal numbers of patients were divided into 2 groups, i.e Group A and group B.

Group A were treated with MTA and Group B were treated with CaOH.

In the group A, MTA was mixed according to the manufacturer's instructions (i.e. 1:3 water/ powder ratio) and applied to the site of exposure on the pulpal floor where pulp were exposed

either due to the deep caries approaching to the pulp or due to the mechanical exposure during the carious removal then a cotton pellet soaked in normal saline and were placed over the MTA and cavity was sealed temporarily with intermediate restorative material (cavit). After 24 hours, setting of the MTA was evaluated by checking the hardness of the MTA with the dental probe. A layer of RMGIC (GC Fuji II) Liner was placed that was followed by the direct composite (nano hybrid) restoration.

In Group B, CaOH was mixed with saline and was applied over the exposure site that was followed by the RMGIC liner and filled with the direct composite restoration.

Patients in both groups were encouraged to follow up to check on the discomfort and sensitivity of the tooth after 24 hours, a week, three months and six months. After the surgery, the patients were told to record their level of discomfort using the Visual Analogue Scale (VAS). This was done for the first seven days, followed by three and six months thereafter.

Positive sensibility test results, no pain during percussion, no signs or manifestations of irreversible pulpitis, and vital pulp as determined by clinical or radiographic examinations after six months are all requirements for a good result.

DATA ANALYSIS

"Statistical Package for Social Science, SPSS Version 23.0" (IBM Corp, Armonk, NY, USA) was used to analyse the data. Quantitative data like age and VAS were computed using mean and standard deviation, whereas qualitative variables like gender was provided as frequency and percentage. The severity of pain was compared between two groups by using chi-square test and the p-value equal to or less than.05 was considered statistically significant.

RESULTS

Comparative studies of the clinical results of direct pulp capping in adult permanent teeth using mineral trioxide aggregate and calcium hydroxide included a total of 60 individuals. In this study 66.7% were males and 33.3% were females in CaOH group, 46.7% males and 53.3% were females in MTA group out 30 cases of each group respectively. The findings were statistically insignificant (0.118). The mean age of the patients was 27.13+4.59 years in CaOH group and 27.43+4.40 years in MTA group. Table-I

According to presenting complaints of the patients, pain and sensitivity was in 66.7% cases, 20.0% had cold sensation and pain on cold and hot stimuli was in 13.3% of the cases of CaOH group. On other hand pain and sensitivity was in 86.7% cases and 13.3% had cold sensation of the cases of MTA group (p-0.075). Table-II

According to the pre-operative pain the most of the patients had moderate to severe pain in both groups as 40.0% and 46.7% in CaOH group and 20.0% and80.0% in MTA group respectively. According to the post-operative pain after 24 hours and at 7th postoperative day, 60.0% had mild pain, and 6.7% had severe pain in CaOH group, while 46.7% patients had moderate pain and no any case found with severe pain in MTA group. Severity of the post-operative pain was less in MTA group. On pain assessment after 3 months, only 13.3% cases had mild pain in CaOH group, while no any case found with pain in MTA group. Postoperative pain at 7th month was almost decreased completely in both groups, only 2 patients had mild pain in CaOH group. Table-III

Pre-operative test validity was positive in all of the cases, and it remained positive also in all the cases till 6th month's follow-up, which indicted that no nay cases had developed necrosis after treatment in both groups. Table-III

Furthermore, in this study, there was no any cases found with radiological abnormalities during follow-up of 24 hours to 6 month post-operatively in both groups, results shown in Table-V.

Variable	CAOH	MTA	Total	P-Value
Gender				
Male	20	14	34	0.118
Female	10	16	26	
Age				
Mean	27.13 Years	27.73 Years	27.43 Years	0.602
Standard Deviation	4.59 Years	4.25 Years	4.40 Years	

Table-I. Descriptive statistics of age and gender comparison in both study groups n=60
CaOH= Calcium Hydroxide MTA= Mineral Trioxide Aggregate

Variables		Study Groups		Total	P-Value
		CaOH	MTA		
Complaints	Pain and sensitivity	20	26	46	0.075
		66.7%	86.7%	76.7%	
	Cold sensation	6	4	10	
		20.0%	13.3%	16.7%	
	Pain on cold and hot stimuli	4	0	4	
		13.3%	0.0%	6.7%	
Total		30	30	60	
		100.0%	100.0%	100.0%	

Table-II. Presenting complaints of the patients in both study groups n=60

Variable	Pain	MTA	CAOH	Total	P-Value
Pre Operative Pain	Mild	4	0	4	0.013
	Moderate	12	6	18	
	Severe	14	24	38	
Postoperative Pain after 24 hours	No Pain	10	16	26	0.143
	Mild	18	14	32	
	Moderate	2	0	2	
Postoperative Pain after 7 days	No Pain	10	16	26	0.001
	Mild	18	14	32	
	Moderate	2	0	2	
Postoperative Pain after 3 months	No Pain	26	30	56	0.038
	Mild	4	0	4	
Postoperative Pain after 6 months	No Pain	28	30	58	0.150
	Mild	2	0	2	

Table-III. Pre and Post-operative pain comparison in both study groups n=60

Variable	Pain	MTA	CAOH	Total	P-Value
Post-operative test validity	Positive	30	30	60	0.100
	Negative	--	--	--	
Post-operative test validity from 24 hours to 6 months	Positive	30	30	60	0.100
	Negative	--	--	--	

Table-IV. Pre and Post-operative test validity in both study groups n=60

Variable	Pain	MTA	CAOH	Total	P-Value
Post-operative radiological evaluation after 24 hours	Normal	30	30	60	0.150
	Not Normal	--	--	--	
Post-operative radiological evaluation after 7 days	Normal	30	30	60	0.150
	Not Normal	--	--	--	
Post-operative radiological evaluation after 3 months	Normal	30	30	60	0.150
	Not Normal	--	--	--	
Post-operative radiological evaluation after 6 months	Normal	30	30	60	0.150
	Not Normal	--	--	--	

Table-V. Post-operative radiological evaluation comparison in both Study groups n=60

DISCUSSION

In situations with an open apex, direct pulp capping treatment is meant to prevent or delay root canal therapy and maintain the life of the pulp.[7] The gold standard material in the past was calcium hydroxide (CH), however today's usage of mineral trioxide aggregate (MTA) may enhance the outcome of teeth following pulp exposure. In this study according to the post-operative pain after 24 hours, 60.0% had mild pain, and 6.7% had severe pain in CaOH group, while 46.7% patients had moderate pain and no any case found with severe pain in MTA group. Severity of the post-operative pain was less in MTA group while findings were statistically insignificant (p-0.143). Similarly on the 7th post operative day 60.0% patient□s had mild pain and 6.7% cases had moderate pain in CaOH group, while 46.7% had mild pain and no case was found with moderate or severe pain in MTA group out of 30 cases in each group. Severity of pain was less in MTA group compared to CaOH group; the results were statistically significant (p-0.001). On the pain assessment after 3 months, only 13.3% cases had mild pain in CaOH group, while no any case found with pain in MTA group (p-0.038), while post operative pain on 7th month were almost decreased complete in both groups, only 2 patients had mild pian in CaOH group (p-0.150). Above observations showing that the mineral trioxide aggregate (MTA) better in terms of early relief of pain. After direct pulp capping, Mente J et al[7] repeatedly found that MTA seems to be more successful at preserving long-term pulp vitality than calcium hydroxide. On the other hand, DPC may be used to effectively manage teeth with carious pulp exposures and reversible pulpitis. In terms of both accomplishment rate and pain severity, MTA outperformed CaOH.

A biologically active substrate known as mineral trioxide aggregate (MTA) has been found to control dentinogenic processes in pulp cells 16. It is superior to CH in the absence of an inflammatory response and promotes the production of robust dentin bridges with greater predictability.[8] Research assessing CaOH and MTA indicated no difference in DPC failure rates for primary teeth, while MTA had a much reduced failure rate for permanent teeth. Nevertheless, comparison and interpretation are constrained by the small number of high-quality research.[9,10] This study's authors, Çalışkan MK et al., found that the MTA-capped teeth had a somewhat greater success rate than CaOH, indicating that it is a dependable direct pulp-capping material.

In this study the mean age of the patients was 27.13+4.59 years in CaOH group and 27.43+4.40 years in MTA group, 66.7% were males and 33.3% were females in CaOH group, 46.7% males and 53.3% were females in MAT group out 30 cases of each group respectively. The findings were statistically insignificant (0.118). According to presenting complaints of the patients, pain and sensitivity was in 66.7% cases, 20.0% had cold sensation and pain on cold and hot stimuli was in 13.3% of the cases of CaOH group. On other hand pain and sensitivity was in 86.7% cases and 13.3% had cold sensation of the cases of MTA group (p-0.075). Chemically, the MTA is made up of a powder (white or grey) made up of hydrophilic granules that solidify when exposed to water. Tricalcium silicate, tricalcium aluminate, tricalcium oxide, silicate oxide, and bismuth oxide (which provides it radiopacity) are the key ingredients in the combination that creates this powder.

It is handled by mixing with distilled water that the producers provide.[12,13] The literature's description of its mechanism of action is centred on the ideas that MTA ways CaOH that eliminates calcium ions, favouring cell adhesion and proliferation; establishes an environment that is antibacterial by maintaining an alkaline pH; modulates the production of cytokines; promotes the differentiation and migration of cells that will form an extracellular matrix to be mineralized; and forms hydroxyapatite or carbonated apatite on the surface in contact with the MTA, supplying a biologic seal.[14] The good sealing capability of the repair, which renders even little infiltration challenging, its low solubility, and its acceptable radiopacity are yet further elements that appear to work in its favour.[15,16] High success rates for pulp capping treatments have been shown in a number of studies in the literature, mostly via clinical and

radiographic assessments. In a randomised clinical experiment, Brizuela et al[1] directly covered permanent teeth with pulp exposure in CH, MTA, or Biodentine. Clinical assessments were conducted at 1 and 3 weeks, 6 months, and 1 year as a follow-up. Individuals demonstrated 100% clinical success rates across all groups in only one week. A few failure instances might be seen over time, notably in the CaOH group. No statistically significant difference existed between the materials.

CONCLUSION

After direct pulp capping, the both mineral trioxide aggregate and calcium hydroxide in the mature permanent teeth observed to be effective, but MTA seems to be more efficient than calcium hydroxide at preserving long-term pulp vitality**.** Future randomized trials that are well planned and powered appropriately are needed to ascertain whether these results are true in order to eliminate remaining uncertainty.

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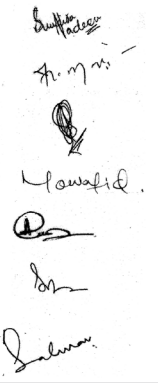
1	Sumaira	Principal Author, Data Collection.	
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