International Journal of Medical Toxicology & Legal Medicine Volume 27, No. 1s, 2024
e-ISSN: 0974-4614
p-ISSN: 0972-0448

Article Submitted: 12-05-2024; Revised: 25-06-2024; Accepted: 22-07-2024

Comparative Study on Ph Change in Root Dentine & Gutta Percha

[1]Dr.Amit Bajirao Jadhav, [2]Dr.Shivsagar Tirthnath Tewary, [3]Dr.Karuna Gajanan Pawashe, [4]Dr. Savita Hadakar, [5]Dr. Sonali Waghmode, [6]Dr. Sachin Gugwad,

[1]Asst. Professor, amit27986@gmail.com
[2]Asso. Professor, ssagartewary@gmail.com
[3]Asst. Professor, karuna.pawashe@gmail.com
[1,2,3]Dept. of Prosthodontics, School of Dental Sciences, Krishna Vishwa Vidyapeeth "Deemed to be University",Taluka-Karad, Dist-Satara, Pin-415 539, Maharashtra, India
[4]Asso. Professor, drsavita0485@yahoo.co.in
[5]Asst. Professor, drsonaliwaghmode@gmail.com
[6]Asso. Professor, drsachdent@yahoo.co.in
[4,5,6]Dept. of Paedodontics, School of Dental Sciences, Krishna Vishwa Vidyapeeth "Deemed to be University",Taluka-Karad, Dist-Satara, Pin-415 539, Maharashtra, India

ABSTRACT

Background: $Ca(OH)_2$ produces a pH of over 11.1 which contributes to its antibacterial effects. Necrotic pulp and dentin has a pH of 6.0–7.4, however, after placing $Ca(OH)_2$ in the canal, the peripheral dentin has a pH range of 7.4–9.5.
Aim: To evaluate change of pH in root dentine (RD) & GP.
Material & method: 120 sample single extracted tooth assessed for pH with 2 different groups i.e group 1 as $Ca(OH)_2$ with vehicle for RD and grouup 2 with MGP.
Result: We found statistically significant change for RD & GP.
Conclusion: We come to conclude that , an alkaline pH was present in Ca(OH)2 preparation & MGP.
Keywords: MGP, RD, $Ca(OH)_2$,necrotic pulp, pH,antibacterial,dentin,alkaline, extracted teeth.

INTRODUCTION

This encompasses the traditional methods of debridement and disinfection, which have been enhanced by the development of more advanced intracanal(IC) irrigation protocols and medicines, as well as improved techniques for obturation and coronal restoration. Furthermore, it encompasses the process of devising a treatment plan and formulating a diagnosis.[1] It is not possible for chemomechanical preparation to eradicate all of the microorganisms that are present in the dentinal tubules on its own. There is a possibility that the microorganism will grow if there is no effective intracanal medication (ICM) available in the interim between the sessions. Because of this, it is essential to have a reliable ICM for cleansing the RC. The elimination of the microorganisms that are present inside the RC and the prevention of reinfection are the primary goals that are being pursued by the notion of administering an intracanal medication. In situations where a single visit treatment is not appropriate, it is recommended that a medication that has a long-lasting impact and causes the least amount of irritation to the tissue around the radius be used to eliminate germs. [2]

The first reports documenting the successful healing of periapical lesions with $Ca(OH)_2$ were published between 1934 and 1941.[3] MGP, which include $Ca(OH)_2$, are seldom used due to their delayed release of Ca+ and OH- ions. Alternatively, other forms of medicated gutta percha, such as those that release chlorhexidine(CHX) or silver nano particles (Ag-NP), provide a continuous release mechanism and efficient disinfection. These drugs also have strong antibacterial activities, however there is no basis for comparison across various groups. This study aims to investigate the influence of pH variation on antibacterial activity by evaluating the pH change in root dentin between two major groups. [4]

AIM

To compare & evaluate the pH change in root dentin after placing $Ca(OH)_2$ with various vehicle & medicated gutta percha (GP) as intra-canal medicaments(I-C M)

INCLUSION CRITERIA

1. Orthodontic purpose
2. Mobile teeth

EXCLUSION CRITERIA

1. Grossly decayed
2. Teeth with fracture
3. Teeth with 2 roots
4. Teeth with resorbed roots

MATERIAL & METHOD

Material

1) Preparation of samples:-
    a. Modelling Wax
    b. Sterile gloves
    c. Mouth mask
    d. 17% Ethylene diamine tetra acetic acid
    e. 3% NaOCl
    f. Normal saline
    g. Distilled water
    h. Nail Varnish
    i. Contra- angled handpiece
    j. Diamond disc
    k. Airotor
    l. Straight bur
    m. Gates glidden drills
    n. Needle & Syringe
    o. Autoclave
2) For preparation & placement of intracanal medicament
    a. $Ca(OH)_2$ powder
    b. Metapex
    c. Vehicles – Normal Saline(NS) : 10 % Propylene Glycol
    d. Mixing pad & spatula
    e. Syringe & needle tips
    f. Lentulospiral
3) For placement of medicated GP
    a. $Ca(OH)_2$ releasing GP
    b. 20.6% GP
    c. Silver Nano particle
    d. 2% Chlorhexidine gel
    e. Paper points
4) For decoronation of teeth at CEJ
    a. Carborundum disc
    b. Straight Handpiece
    c. Motor
5) For checking pH : Digital pH meter
6) For root canal preparation

a. 10 & 15 no.K files
b. Neo Endo flex files 21 & 25 mm
c. Endo motor

SELECTION OF TEETH

In our in-vitro study 120 intact permanent single rooted extracted teeth were collected , irrespective of patient age & sex.

PREPARATION OF SAMPLES FOR EVALAUTION

A coronal access cavity preparation was made in a conventional manner. A 10 no K file was inserted into each root canal until it reached the apex, at which point its length was measured and 1 mm was subtracted as shown in figure 1.

FIGURE. 1: ACCESS OPENING OF SAMPLE

The canal were then enlarged by instrumentation upto size 20, with copious irrigation of 3% NaOCl followed by NS . Then biomechinal preparation was done using Neoendo flex files upto size 20.04% as shown in figure 2.

FIGURE. 2: ACCESS OPENING AND WORKING LENGTH RVG

Decoronation of teeth were done at the CEJ with carborundum disc with a straight hand piece along with water spray as shown in figure 3.

FIGURE. 3: TOOTH SAMPLE DECORONATED

Glyde was then dispensed into the root canal & external cavity measuring 3 & 1 mm of diameter & depth respectively were produced on mesial side using a round bur. To completely eliminate the glyde were rinsed with 10 ml of pure water afterward. Before administering any medicaments, canal of each tooth were dried with paper points as shown in figure 4.

FIGURE. 4: EXTERNAL CAVITY ON MESIAL SURFACE OF THE SAMPLE

PLACEMENT OF MEDICAMENTS

One hundred twenty teeth which were selected for study were then randomly assigned to 2 ain groups for instruments as follows (n=60) :-
The main group was divided into 4 subgroup (n=15)

Group 1) $Ca(OH)_2$ with vehicle

Subgroup A- Canals were left Empty (n=15)
Subgroup B- Calcium hydroxide with Saline (n=15)
Subgroup C- Calcium hydroxide with Propylene glycol(n=15)
Subgroup D- Metapex (n=15)

Group 2) Medicated GP

Subgroup A- Canal were left em[ty (n=15)

Subgroup B- $Ca(OH)_2$ releasing GP (n=15)

Subgroup C – Chlorhexidine releasing GP (n=15)

Subgroup D – Silver nanoparticles releasing GP (n=15)

Group 1- $Ca(OH)_2$ with different vehicle

In sub-group A : As a control, the root canal were left unfilled.

In sub-group B : A paste of $Ca(OH)_2$ & NS was used to fill the root canals. To amke the paste, 130 mg of $Ca(OH)_2$ was combined with 0.25 ml of NS.In order to include the most $Ca(OH)_2$ while producing a thick, creamy paste , powder to liquid ratio was calculated.The paste was applied with a no.20 K – file and material was then compacted with hand plugger. To verify the homogeneity of paste & absence of any voids in the root canal, radiograph were acquired.
In sub-group C: A manually made paste of propylene glycol & pure $Ca(OH)_2$ powder was used to fill the root canal. A paste was created by combining 0.25 ml of propylene glycol with 130 mg of $Ca(OH)_2$ powder. The ratio of powder to liquid was chosen to include the most $Ca(OH)_2$ while producing a thick, creamy consistency . After applying the prepared paste with no. 20 K file & compacting it with hand plugger, material was laid down.
In sub-group D: The root canal were filled with Metapex in this group, radiographs were taken confirm the homogenicity of paste fill & absence of voids in root canal.

Group 2 – Medicated (M) GP
In sub-group A: As a control , root canal were left unfilled.
In sub –group B: Multiple Ca $(OH)_2$ points were used to fill the root canal.These points were positioned passively in the canal, in accordance with the maufacture instructions & without applying anyy force till the operating length, condensation.
In sub-group C: The root canal were filled with single GP coated with 2% chlorhexidine gel & were placed according to the last file used, passively in the canal till the working length.

In sub-group D: The root canal were filled with single GP coated with silver nanoparticles & were placed according to the last file used, passively in the canal till the working length as shown in figure 5.

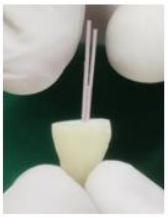

FIGURE 5: PLACEMENT OF MEDICATED GP

STATISTICAL ANALYSIS

We have used ANOVA, independent t- test (independent & paired sampling) & turkey post hoc test using SPSS (16.0) window software.

RESULT

GROUP 1- CA $(OH)_2$ WITH VEHICLE

Calcium Hydroxide (Group 1)	1h Mean(SD)	24h Mean(SD)	48h Mean(SD)	1 week Mean(SD)
Subgroup A (CONTROL)	7.148(0.107)	6.958(0.137)	7.022(0.185)	6.9(0.102)
Subgroup B (CH +SALINE)	9.762(0.183)	10.018(0.227)	10.42(0.406)	10.52(0.304)
Subgroup C (CH+PG)	9.262(0.296)	10.162(0.23)	10.72(0.29)	10.918(0.384)
Subgroup D (METAPEX)	9.159(0.255)	9.364(0.27)	9.44(0.166)	9.711(0.201)
One way AnovaF test value	F=402.781	F=671.539	F=540.449	F=674.829
P value(overall)	P<0.001**	P<0.001**	P<0.001**	P<0.001**

TABLE 1 : ANOVA TEST

Group	Comparison Group	1h Mean(SD)	24h Mean(SD)	48h Mean(SD)	1 week Mean(SD)
	Subgroup B				

SubgroupA (CONTROL) vs	**(CH +SALINE)**	p<0.001**	p<0.001**	p<0.001**	p<0.001**
	Subgroup C (CH+PG)	p<0.001**	p<0.001**	p<0.001**	p<0.001**
	Subgroup D (METAPEX)	p<0.001**	p<0.001**	p<0.001**	p<0.001**
SubgroupB (CH + SALINE) Vs	**Subgroup C (CH+PG)**	p<0.001**	p=0.30	p=0.02*	p=0.001*
	Subgroup D (METAPEX)	p<0.001**	p<0.001**	p<0.001**	p<0.001**
Subgroup C (CH+PG) Vs	**Subgroup D (METAPEX)**	p=0.585	p<0.001**	p<0.001**	p<0.001**

TABLE 2: TURKEY POST HOC TEST

In our study, table 1 & table 2 showed that there was no statistically significant difference seen at 1 hour between Group 1 the mean pH For Subgroup B (CH + saline) was highest ie 9.762 and lowest for Subgroup D (Metapex) ie 9.159. At day 1 there was stastically significant difference seen the mean pH For Subgroup C (CH + PG) was highest ie 10.162 and lowest for Subgroup D (Metapex) ie 9.364. At day 2 there was stastically significant difference seen the mean pH For Subgroup C (CH + PG) was highest ie 10.72 and lowest for Subgroup D (Metapex) ie 9.44, But at Day 7 there was no stastically significant difference seen between the mean pH For Subgroup C (CH + PG) was highest ie 10.918 and lowest for Subgroup D (Metapex) ie 9.711. The subgroup B had an aqueous vehicle (saline) at 1hr the mean pH was highest for this group, while lowest for subgroup D as Metapex is oily intracanal medicament. At day 1,2 and 7 subgroup C which had viscous vehicle (Propylene glycol) had the highest mean pH & lowest for subgroup D (Metapex).

GROUP 2- MGP

Gutta Perch	1h Mean(SD)	24h Mean(SD)	48h Mean(SD)	1 week Mean(SD)
Subgroup A (CONTROL)	7.148(0.107)	6.958(0.137)	7.022(0.185)	6.9(0.102)
Subgroup B (GP+CH)	9.737(0.165)	10.358(0.321)	9.84(2.660)	10.41(0.232)
Subgroup C (GP+CHX)	8.251(0.172)	7.692(0.143)	7.743(0.127)	8.228(0.207)
Subgroup D (GP+SILVER NP)	8.228(0.207)	7.769(0.23)	7.527(0.220)	7.958(0.274)

One way Anova Ftest value	F=604.822	F=675.399	F=12.945	F=711.034
P value(overall)	P<0.001**	P<0.001**	P<0.001**	P<0.001**

TABLE 3 : ANOVA TEST

Group	Comparison Group	1h Mean(SD)	24h Mean(SD)	48h Mean(SD)	1 week Mean(SD)
SubgroupA (CONTROL) vs	**Subgroup B (GP+CH)**	p<0.001**	p<0.001**	p<0.001**	p<0.001**
	Subgroup C (GP+CHX)	p<0.001**	p<0.001**	p=0.459	p<0.001**
	Subgroup D (GP+SILVER NP)	p<0.001**	p<0.001**	p=0.731	p<0.001**
SubgroupB (GP+CH)vs	**Subgroup C (GP+CHX)**	p<0.001**	p<0.001**	p<0.001**	p<0.001**
	Subgroup D (GP+SILVER NP)	p<0.001**	p<0.001**	p<0.001**	p<0.001**
SubgroupC (GP+CHX) vs	**Subgroup D (GP+SILVER NP)**	p=0.982	p=0.780	p=0.971	p=0.005*

TABLE 4: TURKEY POST HOC TEST

In our study , table 3 & 4 showed that at 1hr, 1day, 2 day and 7 day the highest mean pH was seen in subgroup B ie Ca(OH)2 points and lowest for subgroup D ie Silver nanoparticles releasing gutta percha, there was stastically significant difference between subgroup B and subgroup D at 24 hr and 48 hr. At 1hr subgroup B had a mean pH of 9.73 and subgroup C and D had 8.25 and 8.22 respectively. At day 1 mean pH of subgroup B increased upto 10.35 while it decreased for subgroup C and D which was 7.69 and 7.76, At day 2 mean pH of subgroup B decreased upto 9.84 while it was increased for subgroup C and D which was 7.74 and 7.52. But at day 7 mean pH of subgroup B increased upto 10.41 and it increased for subgroup C and D which was 8.22 and 7.95 as well.

DISCUSSION

Medicaments play a crucial role in the treatment process, aiding in the healing of lesions. There has been a recent increase in the popularity of single visit endodontics due to advancements in instrumentation, irrigation, and activation techniques. However, there are specific situations in which the clinician is unable to perform therapy in a single visit. For conditions such as swelling, pulp necrosis, trauma, retreatment, and others, it is recommended to consider a treatment that involves

multiple visits. Here, ICM play a crucial role. They have a crucial role in reducing the number of bacteria in the root canal area during single visit RC procedures.[5]

REQUIREMENTS OF MEDICAMENTS [6]

1. Microorganism destruction: The main goal is to eradicate all pathogen or viable mocroorganism.
2. Prevent post-operative pain: The main goal is to reduce or otherwise modify the inflammatory response. The medication will carry out this either by changing inflammatory impact pharmacological or by exerting its antibacterial action.
3. Increasing anaesthesia: Appropriate agents were given to reduce sensitivity of inflamed pulp when it is difficult to anaesthestize the pulp.
4. Control of periapical infection : Severe pain , swelling after treatment or weeping are indicators of an active periapical inflammatory lesion.

METHOD OF APPLICATION OF INTRACANAL(IC) MEDICAMENT (MD) [7]

The method of administration is crucial for placement of medicament essentially 2 strategies are used.

1. Medicament can be applied into root canal space by cotton pellet.
2. Root canal can be filled with prepared medicament.

Apart from this, lentulospiral & paper points can be used for delivery of medicament. $Ca(OH)_2$ is often utilized as an intracanal medicament in endodontics. This chemical has a variety of biological properties, including the capacity to destroy pathogens, disintegrate tissues, reduce tooth resorption, and encourage the creation of hard tissues to aid in healing. [8] $Ca(OH)_2$ is widely recognized as the standard ICM. Additionally, it has the ability to combat endotoxins. The effect it has on microbial biofilms, however, is a topic of debate. When used in conjunction with a vehicle, it separates into positively charged Ca ions and negatively charged OH ions. The primary effects of $Ca(OH)_2$ are attributed to the influence of these ions on crucial tissues, including the formation of solid tissue. The highly alkaline nature of $Ca(OH)_2$ is attributed to the presence of OH ions. The penetration of CH into dentinal tubules is crucial for achieving a pH of 11.5. [9] The second vehicle was propylene glycol, a thick substance. Propylene glycol is a highly effective pharmaceutical vehicle, thanks to its substantial molecular weight (76.09) and its ability to attract and retain moisture. This substance has been proven to possess a strong ability to fight against bacteria. It does not harm tissues and is not a type of medication. It has been shown to have a strong antibacterial effect when given in doses of up to 20%. [10]

MODE OF ACTION & FORMATION OF $Ca(OH)_2$ [11]

The major component of limestone, $CaCO_3$ is naturally occuring rock that present in mountain & sea water crystalline. The following chemical process occur when limestone burn between 900 & 1200 degree celsius.

$$CaCO_3 = CaO + CO_2$$

The end product CaO has a potent corrosive effect. $Ca(OH)_2$ is the result of the interaction between CaO & H_2O which happens as follows:-

$$CaO + H_2O = Ca(OH)_2$$

TYPES OF VEHICLE & THEIR IMPORTANCE

Ca(OH2) is known to have its biological effects amplified when it undergoes ionic dissociation, resulting in the formation of Ca2+ and OH- ions.[12] Consequently, it is crucial to attend to the root canal multiple times until adequate healing is achieved, leading to an uptick in the number of visits (Fava 1991). [13] The large molecular weight of these carriers prevents $Ca(OH)_2$ from dissociating into the tissue and retains the paste in the area for a longer period of time, prolonging the paste's activity and releasing Ca2+ and lower velocity OH-ions, according to Silva (1988). These pastes may stay near vital tissue for long periods of time because of this method. [14]

SALINE

Yoshiba et al. (1994) proposed a unique technique for capping amputee pulps that combines a-tricalciumphosphate, calcium hydroxide powder, and saline. In order to reduce postoperative pain and inflammation. [15]

CONCLUSION

We come to conclude that , during the observation period of 7 days , an alkaline pH was present in $Ca(OH)_2$ preparation & MGP. At 1 hour, a high pH was observed by saline & Ca(OH) from both groups with lowest in Metapex & Ag-NP releasing GP. At 24 hr & 48 hr high pH was observed by propylene glycol group & $Ca(OH)_2$. But minimum in NS, metapex & CHX releasing & Ag-NP releasing GP respectively.

At day 7, pH of propylene glycol recording the highest pH followed by NS & metapex respectively, lastly $Ca(OH)_2$,CHX relseasing & Ag-NP releasing GP respectively. Thus, more studies need to be done in future to validate the results.

REFERENCE

1. BYSTRÖM, A., & SUNDQVIST, G. (1981). Bacteriologic evaluation of the efficacy of mechanical root canal instrumentation in endodontic therapy. European Journal of Oral Sciences, 89(4), 321-328. https://doi.org/10.1111/j.1600-0722.1981.tb01689.x
2. Kumar, A., Tamanna, S., & Iftekhar, H. (2019). Intracanal medicaments–Their use in modern endodontics: A narrative review. Journal of Oral Research and Review, 11(2), 94-99. DOI: 10.4103/jorr.jorr_3_19
3. Mustafa, M., Saujanya, K. P., Jain, D., Sajjanshetty, S., Arun, A., Uppin, L., & Kadri, M. (2012). Role of calcium hydroxide in endodontics: a review. Glob J Med Public Health, 1(1), 66-70. http://www.gjmedph.org/
4. Nerwich, A., Figdor, D., & Messer, H. H. (1993). pH changes in root dentin over a 4-week period following root canal dressing with calcium hydroxide. Journal of endodontics, 19(6), 302-306. https://doi.org/10.1016/S0099-2399(06)80461-9
5. HOSHINO, E., Kurihara-Ando, N., Sato, I., Uematsu, H., Sato, M., Kota, K., & Iwaku, M. (1996). In-vitro antibacterial susceptibility of bacteria taken from infected root dentine to a mixture of ciprofloxacin, metronidazole and minocycline. International endodontic journal, 29(2), 125-130. https://doi.org/10.1111/j.1365-2591.1996.tb01173.x
6. Kim, D., & Kim, E. (2014). Antimicrobial effect of calcium hydroxide as an intracanal medicament in root canal treatment: a literature review-Part I. In vitro studies. Restorative Dentistry & Endodontics, 39(4), 241. https://doi.org/10.5395%2Frde.2014.39.4.241
7. Kahler, S. L., Shetty, S., Andreasen, F. M., & Kahler, B. (2018). The effect of long-term dressing with calcium hydroxide on the fracture susceptibility of teeth. Journal of endodontics, 44(3), 464-469. https://doi.org/10.1016/j.joen.2017.09.018
8. Pérez-Alfayate, R., Algar-Pinilla, J., Mercade, M., & Foschi, F. (2021). Sonic activation improves bioceramic sealer's penetration into the tubular dentin of curved root canals: a confocal laser scanning microscopy investigation. Applied Sciences, 11(9), 3902. https://doi.org/10.3390/app11093902
9. Alaçam, T., Görgül, G., & Ömürlü, H. (1990). Evaluation of diagnostic radiopaque contrast materials used with calcium hydroxide. Journal of Endodontics, 16(8), 365-368. https://doi.org/10.1016/S0099-2399(06)81907-2
10. Leonardo, M. R., Almeida, W. A., da Silva, L. B., & Utrilla, L. S. (1995). Histopathological observations of periapical repair in teeth with radiolucent areas submitted to two different methods of root canal treatment. Journal of Endodontics, 21(3), 137-141. https://doi.org/10.1016/S0099-2399(06)80439-5
11. Hisada, A., Nakamura, K., Toyota, Y., Maeda, A., Yoshihara, T., & Yawaka, Y. (2019). Effects of root canal irrigations on intracanal medication with calcium hydroxide effects in root external resorption models. Pediatric Dental Journal, 29(1), 17-22. https://doi.org/10.1016/j.pdj.2018.10.003
12. Grover, C., & Shetty, N. (2014). Evaluation of calcium ion release and change in pH on combining calcium hydroxide with different vehicles. Contemporary clinical dentistry, 5(4), 434-439. DOI: 10.4103/0976-237X.142803
13. Fava. (1998). Acute apical periodontitis: incidence of post-operative pain using two different root canal dressings. International endodontic journal, 31(5), 343-347. https://doi.org/10.1046/j.1365-2591.1998.00159.x
14. Silva, L. A. B. D., Leonardo, M. R., & Utrilla, L. S. (1991). Rizogênese incompleta: efeitos de diferentes pastas à base de hidróxido de cálcio na complementação radicular e na reparação periapical em dentes de cães-Estudo histológico. Rev. odontol. Univ. Säo Paulo, 29-36. https://pesquisa.bvsalud.org/portal/resource/pt/lil-222381
15. Yoshiba, K., Yoshiba, N., & Iwaku, M. (1994). Histological observations of hard tissue barrier formation in amputated dental pulp capped with α-tricalcium phosphate containing calcium hydroxide. Dental Traumatology, 10(3), 113-120. https://doi.org/10.1111/j.1600-9657.1994.tb00535.x