

## USE OF CALCIUM HYDROXIDE AS AN ANTIMICROBIAL AGENT IN ENDODONTICS

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### ABSTRACT:

Antimicrobial activities of calcium hydroxide were observed in 30 chronically infected root canals in comparison with 2% iodine potassium iodide. It was noted that antimicrobial activities of calcium hydroxide and 2% iodine potassium iodide were similar.

### INTRODUCTION:

The objective of root canal treatment is to restore the teeth to proper form and function, as well as to healthy periradicular conditions<sup>1</sup>. It can be achieved through effective treatment planning, procedure, sterilization of root canal and periapical tissues and hermetically sealing the canal with an inert permanent root filling material<sup>2,3</sup>. The successful outcome of endodontic therapy depends upon the elimination of bacteria and their degradatory by-products from the root canal<sup>4,5</sup>. This can be achieved through biomechanical preparation and inter-appointment root canal medication<sup>6-9</sup>.

It has been shown that reduction in the number of bacteria, which is achieved through biomechanical preparation is temporary if no intra-canal medicament is used<sup>7,9</sup>. It is believed that intra-canal medicaments should have satisfactory antimicrobial activities, without causing unnecessary tissue damage, which still needs to be explored<sup>10-12</sup>.

Although calcium hydroxide has many documented therapeutic benefits in endodontic therapy<sup>13-21</sup>, still it is not categorized as conventional root canal medicament, and through survey of the literature it appears to have antimicrobial effect within root canals and in *in vitro* studies<sup>22-25</sup>.

The purpose of this study is to evaluate and compare the antimicrobial effect of calcium hydroxide as an intra-canal medicament with 2% iodine-potassium iodide, which at present is considered to be an outstanding intra-canal medicament, as it has an excellent antimicrobial activity with lowest toxic effects<sup>11</sup>.

### MATERIALS AND METHODS

This study was carried out in two groups only on upper anterior teeth, irrespective of size of radiographic appearance of periapical or periradicular radiolucencies on patients with ages of 10 years and above. Selection of cases was random for Groups 'A' and 'B'. Sodium thioglycollate fluid medium was used for collection of samples and for incubation at 37<sup>0</sup>C for 24-48 hours. Blood agar and MacConkey agar media were used for subculturing. Only those cases were included in the study which were with negative culture reports of surface of access cavity of the tooth and positive culture report of initial sample of the canal content before complete biomechanical preparation at first visit. Maximum number of visits were five while inter-appointment period was 5-7 days. Normal saline was used as root canal irrigant.

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**Group 'A':** In this group, pharmaceutical grade calcium hydroxide and distilled water paste was used as intra-canal medicament. To make the calcium hydroxide radiopaque, pharmaceutical grade barium sulphate was added to it in a ratio of 8:1<sup>26,27</sup>. Amalgam carrier method was used for placement of calcium hydroxide in the root canals<sup>26,28</sup>.

**Group 'B':** Iodine-potassium iodide 2% solution was used as intra-canal medicament in this group. It consisted of iodine crystals 2 parts, potassium iodide 4 parts, and distilled water 94 parts<sup>29</sup>.

The procedure used was the same as outlined by Moller<sup>30</sup>. Soft caries and leaky fillings if present were removed, the tooth surfaces polished with pumice and tooth isolated with rubber dam. The tooth, the clamp and rubber dam were cleaned with 30% hydrogen peroxide solution and then swabbed with 5% tincture iodine. After drying of tincture iodine, the tooth surfaces were swabbed with sterile 5% sodium thiosulphate solution to inactivate the iodine.

On first visit, three samples with sterile paper ports for bacteriological examination were taken: one to check the surface sterility, other on initial preparation of root canal up to number 40, and the third one after complete preparation of canal up to number 80. Then in case of Group 'A', paste of calcium hydroxide was packed in the canal and access cavity sealed with zinc oxide eugenol cement; in case of Group 'B' cotton pellet sterile soaked and squeezed with 2% iodine-potassium iodide solution was placed in pulp chamber and access cavity was sealed with zinc oxide eugenol cement.

For subsequent visits, two samples for bacteriological examination were taken, one to check the sterility of site of access cavity after adopting thorough disinfectant protocols as in first visit; the second one after removal of medicament and irrigation of the canal.

The canal was re-instrumented circumferentially with last number of instrument of previous visit, then the canal irrigated, dried and sealed with medicament of respective group. Patient in each group was recalled for three more visits at maximum intra-appointment period of 5-7 days. Procedure for subsequent visits was the same in each group. Canal was obturated if previous culture examination report was negative.

In case of negative culture report with wide apical foramen, temporary obturation with calcium hydroxide paste was done, until there was radiographic evidence of apical closure.

## RESULTS

The study was undertaken to compare the antimicrobial effects of calcium hydroxide and 2% iodine-potassium iodide solution in endodontic therapy by observing the cases for culture examination report after each visit for a maximum of up to 5 visits. The observations are presented as results compiled in Tables 1 to 6.

**Table-1. Distribution of cases according to age in Group 'A'.**

S. No.	Age (years)	No. of Cases	Percentage
1.	11 - 20	21	67.7
2.	21 - 30	07	22.6
3.	31 +	03	9.7
Total		31	100

**Table-2. Distribution of culture reports in Group 'A'.**

S. No.	Visits	Culture Report	No. of Cases	Percentage
1.	First	Negative	04	12.9
2.	Second	Negative	03	9.7
3.	Third	Negative	10	32.2
4.	Fourth	Negative	12	38.7
5.	Fifth	Negative	02	6.4

Culture Reversal = Nil.

**Table-3. Distribution of cases according to age in Group 'B'.**

S. No.	Age (Years)	No. of Cases	Percentage
1.	11 - 20	14	46.6
2.	21 - 30	08	26.7
3.	31 +	08	26.7
Total		30	100

**Table-4. Distribution of cases according to culture reports in Group 'B'.**

S. No.	Visits	Culture Report	No. of Cases	Percentage
1.	First	Negative	03	10.0
2.	Second	Negative	03	10.0
3.	Third	Negative	12	40.0
4.	Fourth	Negative	11	36.7
5.	Fifth	Negative	01	3.3
Total			30	100

Number of cases in Group 'A' were thirty one and in Group 'B' thirty. In Group 'A' distribution of cases according to age groups, i.e. 11-20 years, 21 to 30 years and above 31 years was 21 (67.7%), 7 (22.6%) and 3 (9.7%) respectively (Table-1).

The number of negative culture reports in this group was 4 (12.9%), 3 (9.7%), 10 (32.3%), 12 (38.7%) and 2 (6.4%) after first, second, third, fourth and fifth visits respectively (Table-2). No culture reversal was observed.

In Group 'B', distribution of cases according to age groups, i.e. 11-20 years, 21-30 years and above 31 years was 14 (46.6%), 8 (26.7%) and 8 (26.7%) respectively (Table-3).

After first and second visits the culture examination reports were negative in 10% of cases for each visit. On further observation, the negative culture reports were 40% and 36.7% on third and fourth visits, and for the fifth visit it was 3.3% (Table-4). No culture reversal was observed in this group also.

## DISCUSSION

To achieve the objective of endodontic treatment, that is to restore the tooth to healthy periapical and periradicular condition, the phase of biomechanical preparation is said to be a milestone in successful outcome<sup>1,4</sup>. But many studies have shown that inter-appointment intra-canal medication is mandatory to achieve sterility of root canals and to reduce the chances of



contamination between inter-appointment sessions<sup>7,9</sup>. It is essential for intra-canal medication to have sufficient antimicrobial activity without causing unnecessary damage to tissue<sup>31</sup>. In the process of evaluation of endodontic antimicrobial agents, calcium hydroxide was identified as having good antimicrobial range in various *in vitro* and *in vivo* studies, beside having other documented therapeutic effects in endodontic therapy<sup>24, 25, 27, 32-34</sup>.

A number of workers have suggested that the antibacterial effect of calcium hydroxide is dependent on upon the concentration of hydroxyl ions. If hydroxyl ions are consumed by reacting with bacteria, the dissolution of calcium hydroxide continues to maintain the balance of hydroxyl ions<sup>35</sup>.

It is also stated that the changes in the pH of dental tissues is due to diffusion of hydroxyl ions through the dental tubules after placement of calcium hydroxide paste in root canals of non-vital teeth<sup>36</sup>.

Among various filling materials, calcium hydroxide possesses the least irritational effect<sup>37</sup>. It's mineral-ization effects are also well proved<sup>38</sup>.

Although calcium hydroxide appears to possess antibacterial effects on micro-organisms in *in vitro* studies and within the root canals, it was not categorized as a conventional root canal medicament. In the present clinical study, it's antimicrobial activities were compared on the basis of bacteriologic culture examination reports with iodine-potassium iodide 2% solution, which is at present an outstanding example of a root canal medicament that combines excellent antimicrobial activity with lowest toxic effects<sup>39</sup>.

Results of comparison of culture-negative reports in Groups 'A' and 'B' show that number of culture negative reports in Group 'A' are 12.9%, 9.7%, 32.3%, 38.7% and 6.4% after first, second, third, fourth and fifth visits respectively; while in Group 'B' figures are 10% for the first and second visits, and 40.0%, 36.7% and 3.3% for third, fourth and fifth visits respectively (Table-5).

**Table-5. Comparison of negative culture reports in Groups 'A' and 'B' (expressed as percentage).**

No. of Visits	Group 'A'	Group 'B'
First	12.9	10.0
Second	9.7	10.0
Third	32.3	40.0
Fourth	38.7	36.7
Fifth	4.6	3.3

No appreciable significant difference was found in Group 'A' & 'B' in effectivity of their medicament

The comparison of positive culture reports in both the groups is zero at the end of fifth visit (Table-6). No culture reversal was observed in either group.

**Table-6. Comparison of positive culture report in Groups 'A' and 'B'.**

No. of Visits	Group 'A'	Group 'B'
First	87	90
Second	77	80
Third	45	40
Fourth	06	03
Fifth	00	00

Thus no appreciable difference in effectivity of either of the medicaments was noted. The negative culture reports of first visits in Group 'A' (12.9%) and in Group 'B' (10%) are only attributed to biomechanical preparation, which supports the work of various researchers that even though biomechanical or chemomechanical preparation results in reduction of considerable number of micro-organisms, yet inter-appointment intra-canal medication is necessary to achieve complete sterility of the canal<sup>4,6,7</sup>.

Comparison of age groups (Tables 1 & 3) in Groups 'A' and 'B' indicated that age group of 11-20 years is the more common group to have non-vital upper anterior teeth.

Similar studies were carried out by some investigators with some difference in methodologies and their results are comparable with the present study.

Some of them used calcium hydroxide paste as a single application for one month in 35 teeth with necrotic pulp and after one month, viable bacteria were recovered only from one tooth. The comparative medicament used was camphorated monochlorophenol as a single application for 15 days in 30 teeth with necrotic pulp and viable bacteria were recovered in 10 cases. It indicates that prolonged placement of calcium hydroxide in root canals has better bactericidal effect and prolonged placement of camphorated monochloro-phenol has poor bactericidal effect<sup>35,40,41</sup>.

A similar study of comparison of 2% potassium iodide and calcium hydroxide paste with some differences in methodologies was carried out by Safavi et al in 1985; they found better bactericidal effect of calcium hydroxide<sup>41</sup>.

## CONCLUSION

Calcium hydroxide can be used as inter-appointment endodontic medicament, because it possesses good antimicrobial and least irritational effects, beside having other documented therapeutic effects<sup>15-23</sup>. But there are certain limitations, as it's placement in the root canal requires special techniques and it's removal from the root canal is slightly difficult and time consuming.

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