

Clinical and Radiographic Evaluation of Different Herbal Products Infused With Zinc Oxide As An Obturating Material In Primary Teeth – An In Vivo Study

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Abstract

Introduction: The best space maintainer in both primary and mixed dentition is the primary tooth itself which guides the eruption of the succedaneous permanent tooth, stimulate development of maxilla and help in masticatory

process. Complex morphology of the root canal system in deciduous teeth makes it difficult to achieve proper cleansing by mechanical instrumentation and irrigation of the canals. Therefore, to increase the chances of success of the endodontic treatment, root canal filling materials with

antimicrobial properties are frequently used in deciduous teeth.

Aim: To evaluate the efficacy of herbal products infused with zinc oxide as obturating material in primary teeth.

Objectives: To clinically and radiographically evaluate and compare the mixture of zinc oxide powder with *Morinda citrifolia* extract, zinc oxide powder with *Ocimum sanctum* extract, zinc oxide powder with eugenol.

Methodology: A total of 81 children, aged between 4 and 9 years, who were screened for the procedure of pulpectomy were studied. Herbal extracts of *Morinda citrifolia* and *Ocimum sanctum* were prepared according to the MIC and mixed with zinc oxide powder and were used as obturating materials in different groups after performing pulpectomies. Clinical evaluation was undertaken postoperatively after 1 week, 1, 3, 6 and 9 months intervals. Radiographic examination of the treated teeth was carried out at 3, 6, 9 months interval. The data was analyzed statistically.

Results and conclusion: Endodontic treatment using herbal products mixed with zinc oxide powder used as an obturating material showed superior properties clinically and radiographically as compared to zinc oxide eugenol. A detailed observational study with longer follow-up until the exfoliation of teeth will highlight the benefits of herbal products in primary teeth as an obturating material.

Keywords: Pulpectomy, Herbal Products, Obturating Material, *Morinda Citrifolia*, *Ocimum Sanctum*, Zinc Oxide Eugenol

Introduction

The best space maintainer in both primary and mixed dentition is the primary tooth itself. This is not only because of the clinical crown but also due to the presence of roots and periodontium that guide the eruption of the succedaneous permanent tooth. Primary teeth also

stimulate development of maxilla and help in masticatory process.¹The complex morphology of the root canal system in deciduous teeth makes it difficult to achieve proper cleansing by mechanical instrumentation and irrigation of the canals. Therefore, in order to increase the chance of success of the endodontic treatment, substances with antimicrobial properties are frequently used as root canal filling materials in deciduous teeth.³One of the major areas of research is finding obturating materials to suit the specific properties of these teeth i.e. resorption at same rate as roots of the involved tooth, without endangering the succedaneous permanent tooth and its eruption and biocompatibility.¹Zinc oxide eugenol is one of the most widely used materials for root canal filling in primary teeth because of the beneficial effects of Eugenol.¹ It was the first root canal filling material to be recommended for primary teeth by Sweet in 1930.²Bonastre (1837) discovered zinc oxide eugenol, which was subsequently used in dentistry by Chisholm (1876). However, it has many disadvantages like, irritation to the periapical tissues and necrosis of bone and cementum (Erasquin and Muruzabal (1967); slower rate of resorption and alters the path of eruption of succedaneous tooth (Kennedy DB, 1976). It has been reported that the material when extruded from the apex was not resorbed and caused a mild foreign body reaction (Barker and Lockett 1971). The particles of ZOE paste may remain in the alveolar bone as the tooth root is resorbed by physiological resorption (Allen R.K. 1979). Eugenol, in particular, has been reported to be cytotoxic and neurotoxic (Markowitz et al 1992). To overcome the drawbacks of Zinc oxide eugenol, a mixture of calcium hydroxide and zinc oxide as a root canal filling material was used, but this material also got depleted from the canals earlier as compared to the physiologic root resorption. Therefore, the thirst for venturing out an ideal

obturing material that meets all the requirements and criteria is still in an experimental stage. Morinda citrifolia commercially known as Noni or Indian Mulberry has a broad range of therapeutic effects such as anti-bacterial, anti-inflammatory, anti-viral, anti-tumor, anti-helminthic, analgesic and immune enhancing effects that can be advantageous. The research on the use of different solvent extracts of Morinda citrifolia revealed broad spectrum anti-bacterial and anti-fungal activity. The analgesic efficacy of the Noni extract is 75% as strong as morphine, yet non-addictive and side effect free. Tulsi known in English as Holy Basil and botanically called Ocimum sanctum is described as a sacred and medicinal plant in ancient literature. It is herb that is bestowed with enormous antimicrobial substances and used to treat a variety of illnesses ranging from diabetes, arthritis, bronchitis, skin diseases, etc. Ocimum sanctum leaf extract demonstrated maximum antimicrobial activity against microorganisms responsible for dental caries. The composition of O. sanctum extract shows maximum antimicrobial potential against a variety of microorganisms. The constant increase in antibiotic resistant strains and side effects caused by synthetic drugs has elicited and encouraged to look for the herbal alternatives. The advantages of using herbal alternatives are easy availability, cost effectiveness, increased shelf life, low toxicity and lack of microbial resistance. Therefore, the current study is being undertaken to evaluate the efficacy of herbal products infused with zinc oxide powder as an obturing material in the primary teeth.

Aim and objectives

1. To evaluate the efficacy of herbal products infused with zinc oxide as obturing material in primary teeth.

2. To clinically and radiographically evaluate and compare the mixture of zinc oxide powder with Morinda citrifolia extract, zinc oxide powder with Ocimum sanctum extract, zinc oxide powder with eugenol.

Methodology

Clinical and radiographic examination was carried out following which, teeth were assessed and 81 primary molars were selected for study and were equally divided into three groups. Proper case history was taken along with the consent of the parents and assent of the children included in the study.

Group A (n=27) – Zinc oxide powder mixed with Morinda citrifolia extract
 Group B (n=27) – Zinc oxide powder mixed with Ocimum sanctum extract

Group C (n=27) - Zinc oxide powder mixed with Eugenol (control group)

Selection criteria

The inclusion and exclusion criteria are presented in Table 1.

Table 1: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
History of spontaneous pain	Root resorption more than 2/3 rd of root length
Tenderness on percussion	Patients with recent antibiotic exposure
Teeth which are restorable (post endodontic restoration and stainless steel crown)	Patients with systemic illness

Preparation of obturing material: the herbal extracts were prepared according to their respective MIC i.e. Morinda citrifolia 6.25% (Murray et al.¹⁰, Bhardwaj et al.⁵⁴ and Chandwani et al.²⁰ as 6%.) and

Ocimum sanctum as 3.13% which is close to 4% as per the MIC of Ocimum sanctum(Agrawal et al.¹⁴).

Local anesthesia (1:80,000 adrenaline) was administered to the patient and the field was isolated with the help of rubber dam. Straight line access cavity preparation was done. After de-roofing, the coronal pulp was removed with the help of spoon excavator. Extirpation of radicular pulp was done with the help of barbed broach. Radiographical working length determination was done followed by the chemo-mechanical preparation and using saline as an irrigant. All canals were dried using absorbent paper points and were obturated using zinc oxide powder mixed with Morinda citrifolia extract (6%) in the ratio of 1:2 until the desired consistency was obtained for obturation and were included in Group- A, zinc oxide powder mixed with Ocimum sanctum extract (4%) in ratio of 1:2 until the desired consistency was obtained for obturation were included in Group-B and zinc oxide powder and eugenol in the water powder ratio of 1:3 until the desired consistency was obtained for obturation were included in Group-C. Obturation was done using incremental technique using reamers and then thick paste was condensed with the help of hand plugger.²³ Post-obturation radiographic confirmation was done followed by temporary restoration. Patients were evaluated for pain, tenderness after 24-48 hours. After the symptoms have been eradicated, post endodontic restoration was done with type-II restorative glass ionomer cement followed by the stainless steel crown.

Clinical evaluation was undertaken postoperatively after 1 week, 1, 3, 6 and 9 months intervals to evaluate for the pain, tenderness to percussion and signs of pathology, if any.

Radiographic examination of the treated teeth was carried out at 3, 6, 9 months interval to evaluate the increase,

decrease or arrest of radiolucency, and fate of the obturating material.

Results

The collected data was summarized and computed according to the respective groups. At the end of nine months, 4 cases were lost in follow-up (1 from Group A and Group B and 2 from Group C) and 2 were overfilled (2 from Group C) which were then excluded from the study.

The intergroup comparison of obturating materials clinically evaluating postoperative pain at different time intervals between the three groups revealed that at the end of 1 week, 4% of cases obturated with zinc oxide powder and Morinda citrifolia extract have reported with pain while 12% of cases were also reported with pain in zinc oxide eugenol group and no cases were reported with pain in Ocimum sanctum group. At the end of 9 months, 4% of cases were reported with pain in zinc oxide eugenol group while no cases of postoperative pain were reported in other groups after 1 week obturated with zinc oxide powder and Ocimum sanctum extract. Out of the total cases, around 4% had tenderness on percussion even after 9 months follow up in zinc oxide eugenol group. None of the cases had shown any postoperative tenderness after 1 week in group obturated with zinc oxide powder and Ocimum sanctum extract. By using Chi square test, no significant difference was found ($p=0.29$) regarding pain and tenderness between the three groups.

The intergroup comparison of obturating materials clinically evaluating postoperative decrease or complete healing of sinus/fistula at different time intervals between the three groups shows that in Group A comprising of Zinc oxide powder along with Morinda citrifolia extract, 60% of cases had decrease in sinus after 1 week of obturation while 40% were completely healed and similarly in Group B i.e Zinc oxide powder and Ocimum

sanctum extract 40% of cases had decrease in sinus after 1 week of obturation while 60% were completely healed. After 1 month postoperatively, the sinus were completely healed whereas in 40% cases of zinc oxide eugenol group, it was observed that sinus was decreasing and shown complete healing in 3 months follow up. By using Chi square test, no significant difference was found ($p=0.31$) regarding the healing of sinus/fistula between the three groups.

The intergroup comparison of radiolucency in terms of its increase, decrease or arrest radiographically postoperatively at different time intervals between the three groups revealed that in Group A comprising of Zinc oxide powder and *Morinda citrifolia* 16% of cases have shown decrease in radiolucency which gradually decreased to 4% at the end of 9 months while 84% cases have shown arrest in radiolucency at the end of 3 months which increased upto 96% at the end of 9 months. In Group B i.e Zinc oxide powder with *Ocimum sanctum* extract have shown decrease in radiolucency in 8% of cases after 3 months which gradually decreased to 0% at the end of 9 months i.e the arrest in radiolucency was observed. In Zinc oxide eugenol group, 12% cases had shown decrease in radiolucency at the end of 3 months which gradually decreased to 4% at the end of 9 months and 96% of cases have shown arrest in radiolucency after 9 months. By using Chi square test, no significant difference was found ($p>0.05$) radiographically between the three groups.

In the intergroup comparison of fate of obturating material in terms of its resorption or intact radiographically postoperatively at different time intervals between the three groups, it has been observed that the obturating material was intact in all the three groups at all the time intervals.

Discussion

The conservation of a deciduous tooth in a healthy state, functioning as an integral component of the dentition until it is normally exfoliated without endangering the successor is important. The treatment of pulpally necrosed deciduous teeth, the qualities of the paste used for filling are those which determine the prognosis of the tooth.⁷Pulp management of the infected primary teeth involves not only thorough debridement of the root canal system but also obturation by using a material which is biocompatible and would resorb at the same rate as the roots of the involved tooth, without endangering the succedaneous permanent tooth and its eruption. Till date, numerous materials have been tested for their efficiency as a root canal filling material, but none of them have been shown to possess the requisite properties of an ideal root canal filling material for primary teeth. In the present study, clinical and radiographic evaluation of the primary molars are done which were obturated with *Morinda citrifolia* and zinc oxide powder ; *Ocimum sanctum* and zinc oxide powder and eugenol and zinc oxide powder was used as control group. Khairwa et al.¹ in their study used zinc oxide powder and aloe vera gel as an obturating material in primary molars and has shown good clinical and radiographic success. In our study we have used *Morinda citrifolia* extract and *Ocimum sanctum* extract which have also shown good clinical and radiographic success as it is biocompatible and shows faster healing properties. Al-Ostwani AO et al.⁴ in their study evaluated pulpectomy of nonvital primary molars using four different root canal filling pastes zinc oxide and propolis (ZOP) as a new paste, endoflas-chlorophenol-free as a new paste free of chlorophenol, metapex paste, and zinc oxide and eugenol (ZOE) paste as a control paste and found that ZOP is a promising paste with its natural antibacterial component (propolis). ZOE paste had

convergent efficacy to the other pastes. Therefore, in our study we have added herbal products that is *Morinda citrifolia* extract and *Ocimum sanctum* extract with zinc oxide powder to improve its efficacy both clinically and radiographically as an obturating material. Chawla HS et al.⁵ revealed that the mixture of calcium hydroxide and zinc oxide powder was effective to resorb the rarefaction in 2-6 months in two cases coupled with the clinical and radiographic success rate which opens a new venue of research in the direction of using the mixture of two materials to find out the exact proportion that would have the same rate of resorption as that of primary root. Therefore, in our study we mixed herbal products with zinc oxide powder as an obturating material which is very effective both clinically and radiographically. Gupta S, Das G⁶ in their study did clinical and radiographic comparison of zinc oxide eugenol and metapex the success of the treatment was determined after a period of 6 months. In Group I (ZOE) the success rate was 85.71%, i.e., 18 out of 21 teeth and in Group II (Metapex) it was 90.48%, i.e., 19 out of 21 teeth, were considered successful as these teeth were asymptomatic and clinical as well as radiographical signs of pathology were absent and concluded that Metapex could be used as an alternative to ZOE as a root canal material. In our study, the herbal products *Morindacitrifolia* and *Ocimum sanctum* which were used as an obturating material showed good clinical and radiographic success as the teeth obturated with these material were asymptomatic after 1 week follow up and showed no signs of pathology both clinically and radiographically. Murray et. al⁸ from their study concluded that *M. citrifolia* has similar intracanal irrigating properties as that of NaOCl along with EDTA. Previous studies have claimed that the *M. citrifolia* fruit extract shows antifungal effects on *C albicans*.¹¹ Banerjee et al.¹⁴ showed that MCJ had anticandidal activity

invitro. Agarwal et al.¹⁰ determined the antimicrobial activity of *O. sanctum* against *S. mutans* and found that 4% concentration of *O. sanctum* extract showed the widest zone of inhibition against *S. mutans*. Therefore, the same MIC was used in our study of pulpectomy of primary teeth using *Ocimum sanctum* extract along with zinc oxide powder which showed better clinical and radiographic success as an obturating material. Pai RK et al.⁹ in their study analyzed the efficacy of three different concentrations (2.5, 5 and 10%) of *Ocimum sanctum* extract against various microorganisms and stated that *Ocimum sanctum* leaf extract demonstrated maximum antimicrobial activity against microorganisms responsible for dental caries at the 10% concentration level although 5 and 2.5% were also effective. Maximum activity was seen against *S. mutans* and *S. sanguis* with 10% extract. Therefore, *Ocimum sanctum* leaf extract and zinc oxide powder used as an obturating material in our study which was effective in healing all pathological signs associated with them and helped to achieve good clinical and radiographic success. Yamani H A et al.¹³ in their in vitro study evaluated antimicrobial activity of tulsi against three microorganisms i.e. *S. aureus*, *E. coli* and *P. aeruginosa* which showed antimicrobial activity against *S. aureus* (including MRSA) and *E. coli*, but was less active against *P. aeruginosa*. *E. coli* is the most stubborn microorganism found in root canal and responsible for failure of endodontic treatment, thus the *Ocimum sanctum* extract was efficient in overcoming the endodontic failure with its therapeutic properties. Akshat Sachdeva et al.¹² in their review article explained the oral/dental uses of *ocimum sanctum* as it destroys the bacteria that are responsible for dental cavities, plaque, tartar, and bad breath, while also protecting the teeth. It also has astringent properties which make the gums hold the teeth tighter. In our study it showed faster healing properties in case of sinus formation

may be because of astringent properties of the *Ocimum sanctum*. Therefore, in our study the group obturated with *Ocimum sanctum* extract showed better clinical and radiographic success in terms of pain, tenderness and sinus/fistula as compared to *Morinda citrifolia* extract and zinc oxide powder. Due to its astringent properties, it showed faster healing both clinically and radiographically with almost no signs of any discomfort or irritation in soft tissue as well as periapically. *Morinda citrifolia* is also effective against a variety of microorganisms which is helpful in achieving good clinical and radiographic success, and also it has been effectively used as an endodontic irrigant. Both the herbal products were effectively used as an obturating material with good clinical and radiographic success.

Conclusion

This present study demonstrated the efficacy of the obturating materials used in primary molars.

1. All the three obturating materials were successful both clinically and radiographically.
2. Herbal products mixed with zinc oxide powder used as an obturating material showed superior properties clinically and radiographically as compared to zinc oxide eugenol.
3. Incorporation of *Morinda citrifolia* extract and *Ocimum sanctum* extract with ZOE increases their antimicrobial activity which showed faster healing in gingiva and soft tissue in case of sinus or fistula.

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Legend Tables and Figures

Clinical Evaluation

Table 1a: Comparative clinical evaluation of postoperative pain between the three groups

Herbal Product	Follow-Up	Yes	No
Morindacitrifolia	1 week	1(4%)	24(96%)
	1 month	0(0%)	25(100%)
	3 months	0(0%)	25(100%)
	6 months	0(0%)	25(100%)
	9 months	0(0%)	25(100%)
Tulsi	1 week	0(0%)	25(100%)
	1 month	0(0%)	25(100%)
	3 months	0(0%)	25(100%)
	6 months	0(0%)	25(100%)
	9 months	0(0%)	25(100%)
Zinc Oxide Eugenol	1 week	3(12%)	22(88%)
	1 month	0(0%)	25(100%)
	3 months	0(0%)	25(100%)
	6 months	0(0%)	25(100%)
	9 months	1(4%)	24(96%)
	χ^2 -Value	1.08,p=0.29,NS	

By using descriptive and inferential statistics, the p value is statistically not significant (0.29).

Table 1b: Comparative clinical evaluation of postoperative tenderness between the Three Groups

Herbal Product	Follow-Up	Yes	No
Morindacitrifolia	1 week	1(4%)	24(96%)
	1 month	0(0%)	25(100%)
	3 months	0(0%)	25(100%)
	6 months	0(0%)	25(100%)
	9 months	0(0%)	25(100%)
Tulsi	1 week	0(0%)	25(100%)
	1 month	0(0%)	25(100%)
	3 months	0(0%)	25(100%)
	6 months	0(0%)	25(100%)
	9 months	0(0%)	25(100%)
Zinc Oxide Eugenol	1 week	3(12%)	22(88%)
	1 month	0(0%)	25(100%)
	3 months	0(0%)	25(100%)
	6 months	0(0%)	25(100%)
	9 months	1(4%)	24(96%)
	χ^2 -Value	1.08,p=0.29,NS	

By using descriptive and inferential statistics, the p value is statistically not significant (0.29).

Table 1c: Comparative clinical evaluation of sinus/fistula between the three groups

Herbal Product	Follow- Up	Decreasing Sinus	Healed Sinus	No Change
Morindacitrifolia	1 week	3(60%)	2(40%)	0(0%)
	1 month	1(20%)	4(80%)	0(0%)
	3 months	0(0%)	5(100%)	0(0%)
	6 months	0(0%)	5(100%)	0(0%)
	9 months	0(0%)	5(100%)	0(0%)
Tulsi	1 week	2(40%)	3(60%)	0(0%)
	1 month	0(0%)	5(100%)	0(0%)
	3 months	0(0%)	5(100%)	0(0%)
	6 months	0(0%)	5(100%)	0(0%)
	9 months	0(0%)	5(100%)	0(0%)
Zinc Oxide Eugenol	1 week	5(100%)	0(0%)	0(0%)
	1 month	2(40%)	3(60%)	0(0%)
	3 months	0(0%)	5(100%)	0(0%)

	6 months	0(0%)	5(100%)	0(0%)
	9 months	0(0%)	5(100%)	0(0%)
	χ^2 -Value	1.08,p=0.31,NS		

By using descriptive and inferential statistics, the p value is statistically not significant (p=0.29).

Radiographic Evaluation

Table 2a: Comparative evaluation of postoperative radiolucency between the three groups

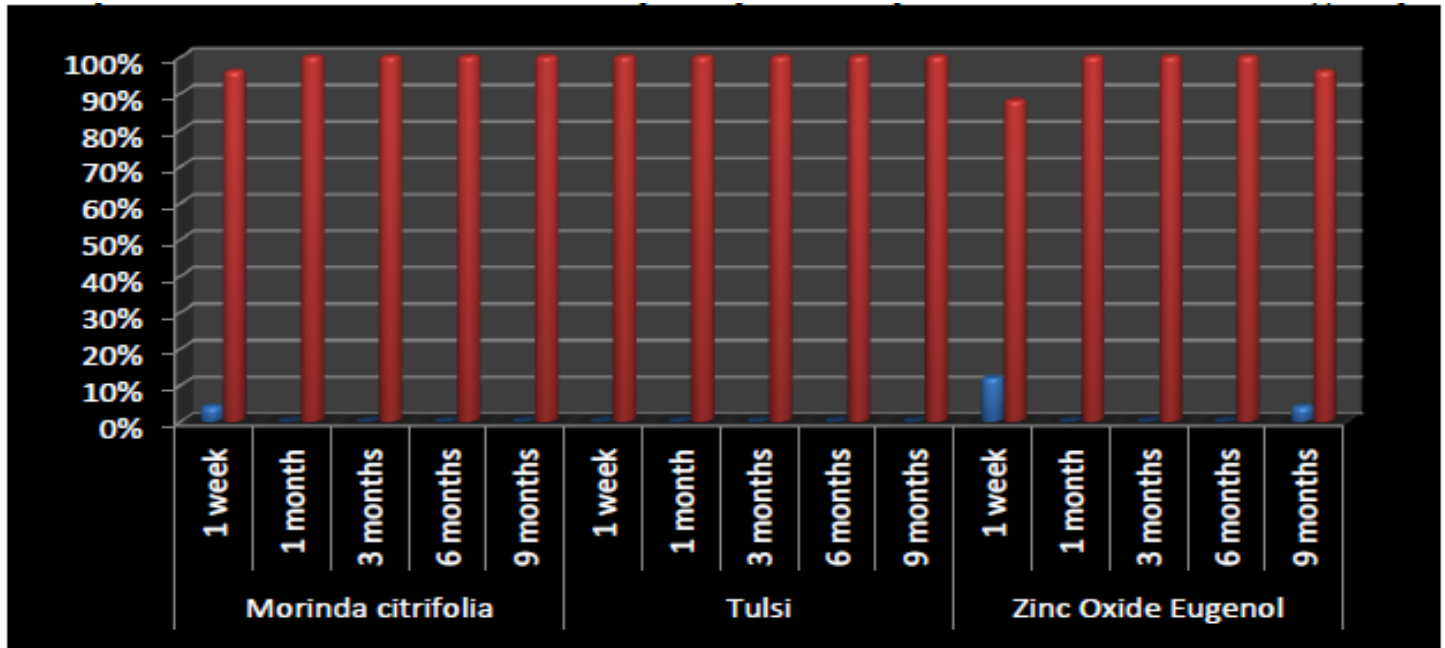
Herbal Product	Follow-Up	Resorbed	Intact
Morindacitrifolia	3 months	0(0%)	25(100%)
	6 months	0(0%)	25(100%)
	9 months	0(0%)	25(100%)
Tulsi	3 months	0(0%)	25(100%)
	6 months	0(0%)	25(100%)
	9 months	0(0%)	25(100%)
Zinc oxide Eugenol	3 months	0(0%)	25(100%)
	6 months	0(0%)	25(100%)
	9 months	0(0%)	25(100%)

By using descriptive and inferential statistics, the p value is statistically not significant (p=0.37, 0.35,0.39 respectively)

Table 2b: Comparative radiographic evaluation of obturating material between the three groups

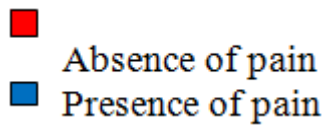
Herbal Product	Follow-Up	Increase	Decrease	Arrest	χ^2 -Value
Morindacitrifolia	3 months	0(0%)	4(16%)	21(84%)	1.95 p=0.37,NS
	6 months	0(0%)	3(12%)	22(88%)	
	9 months	0(0%)	1(4%)	24(96%)	
Tulsi	3 months	0(0%)	2(8%)	23(92%)	2.08 p=0.35,NS
	6 months	0(0%)	1(4%)	24(96%)	
	9 months	0(0%)	0(0%)	25(100%)	
Zinc oxide Eugenol	3 months	0(0%)	3(12%)	22(88%)	1.08 p=0.58,NS
	6 months	0(0%)	2(8%)	23(92%)	
	9 months	0(0%)	1(4%)	24(96%)	

Graph 1: Comparative clinical evaluation of postoperative pain between the three groups

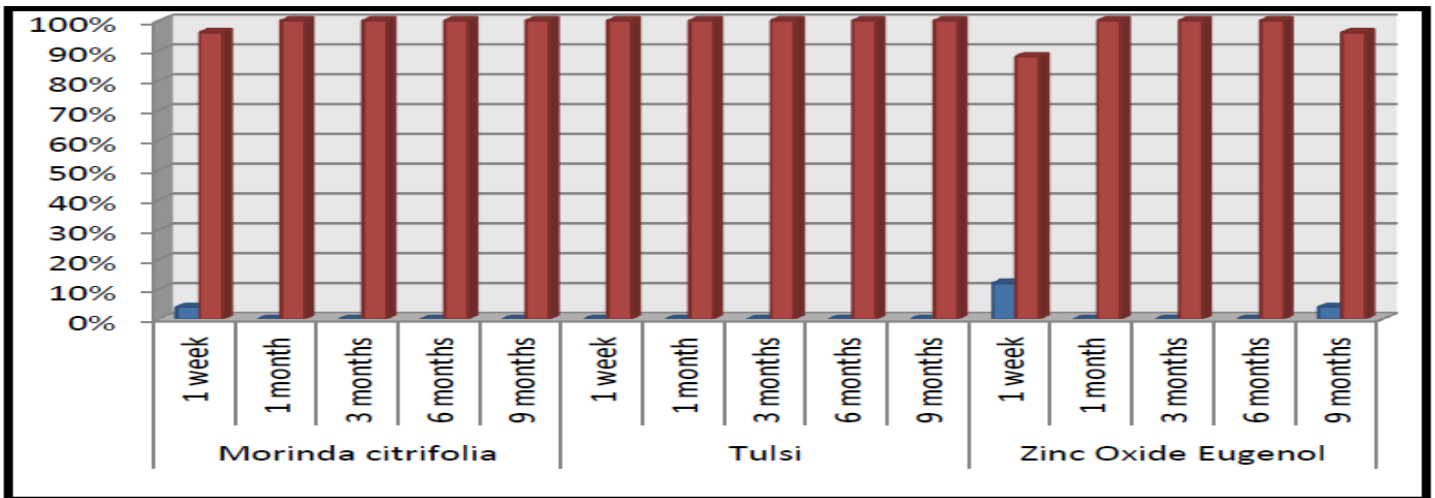


➤ X axis- indicates the percentage of cases reporting with post-operative pain in particular group.

➤ Y-axis denotes follow up visit of all groups

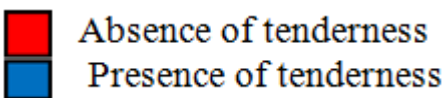


Graph 2 : Comparative clinical evaluation of postoperative tenderness between the three groups

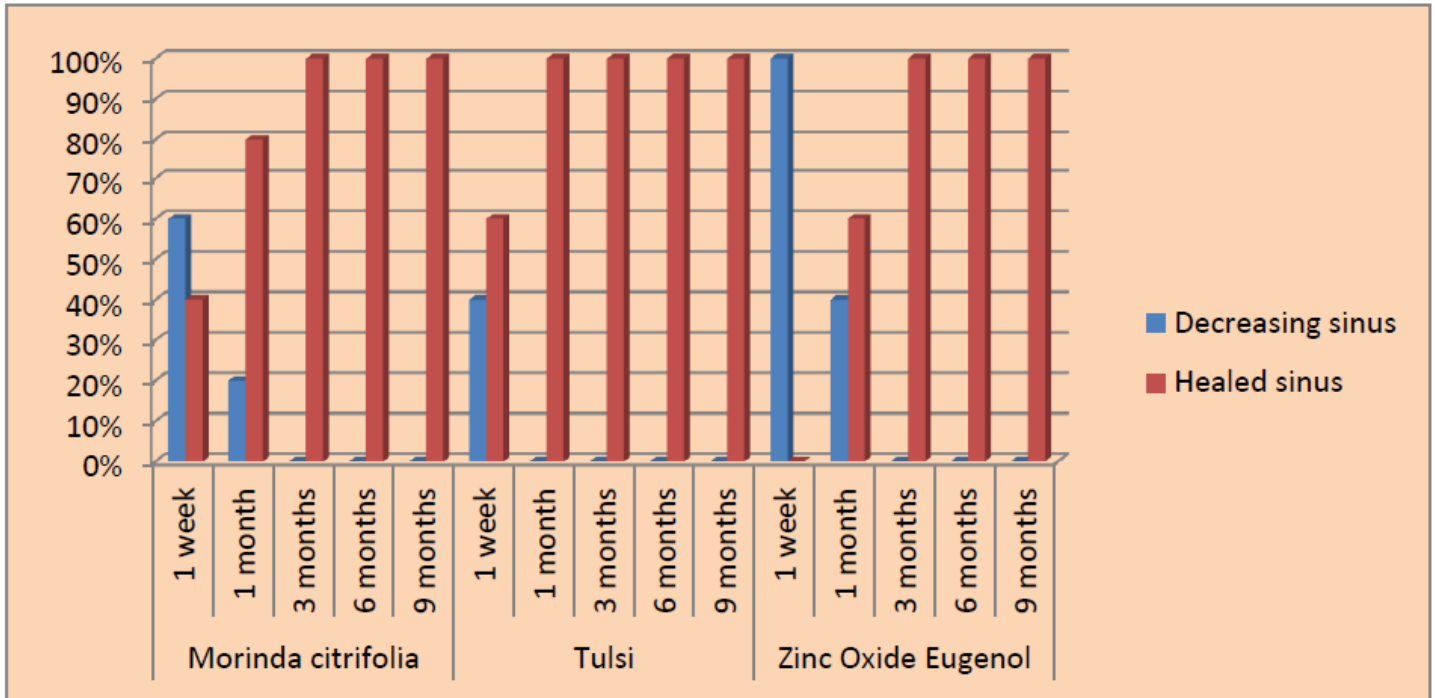


➤ X axis- indicates the percentage of cases reporting with post-operative tenderness in particular group.

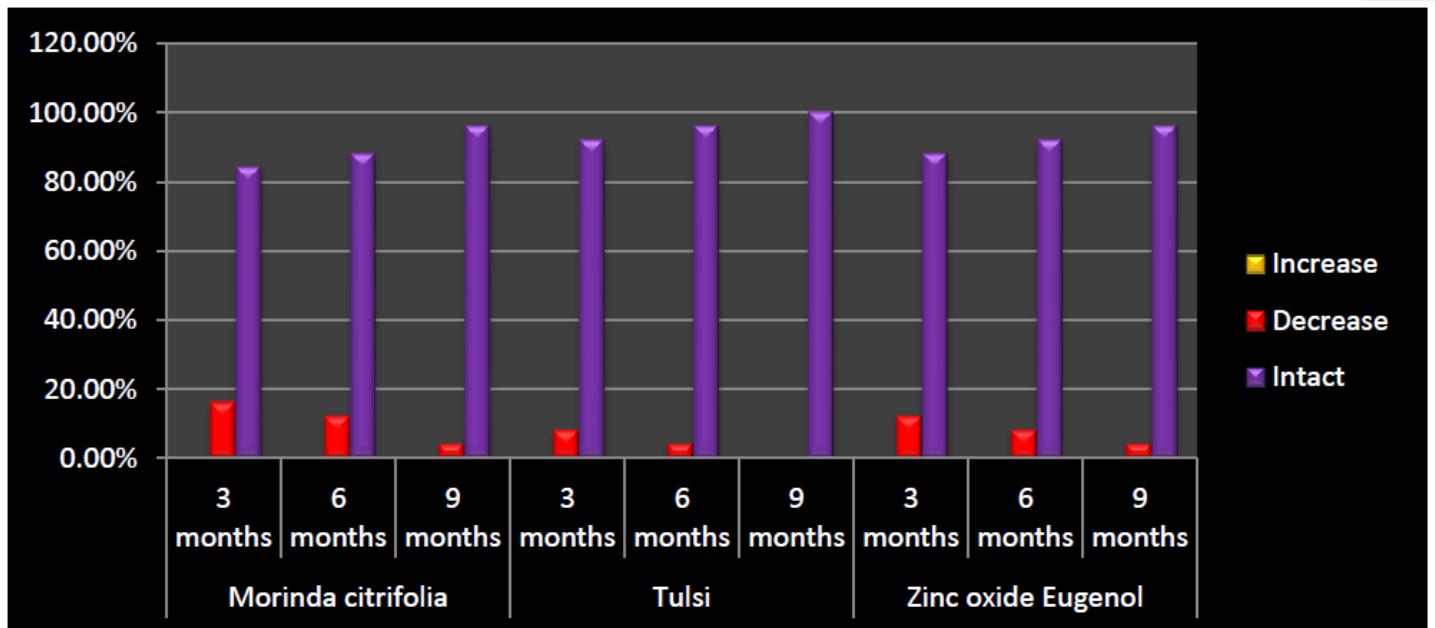
➤ Y-axis denotes follow up visit of all groups



Graph 3: Comparative clinical evaluation of postoperative presence of sinus/fistula or swelling between the three groups



Graph 4: Comparative evaluation of postoperative radiolucency between the three groups



Graph 5: Comparative radiographic evaluation of Obturating material between the three group

