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Radiographic Healing After Root Canal Obturation with MTA Fillapex Versus Sealapex in Non-Vital Teeth with Periapical Lesions: A Six-Month Comparative Study

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ABSTRACT
Background: *Periapical lesions result from pulpal infection and inflammation; successful healing depends on effective root canal obturation and the bioactivity of the sealer. MTA-based sealers, such as MTA Fillapex, have shown promising regenerative properties compared to conventional calcium-hydroxide sealers like Sealapex. This study aimed to compare the clinical and radiographic healing efficacy of MTA Fillapex and Sealapex in non-vital teeth with periapical lesions over six months.*
Methods: *This comparative clinical study was conducted in the Department of Conservative Dentistry and Endodontics, BSMMU, Dhaka, from December 2015 to November 2016, with ethical approval and informed consent. A total of 100 non-vital teeth with radiographic periapical lesions were randomly divided into two groups: Group I (MTA Fillapex) and Group II (Sealapex). Standardized endodontic procedures, including cleaning, shaping, and obturation by lateral condensation, were performed. Clinical parameters (pain, tenderness, and swelling) and radiographic assessments (lesion size and PAI score) were recorded at baseline, 3 months, and 6 months. Data were statistically analyzed using the Chi-square and Student's t-tests, with significance set at $p < 0.05$.*
Results: *Both groups demonstrated progressive clinical and radiographic improvement over six months. Postoperative tenderness significantly decreased in all cases, with no notable intergroup differences (*$p > 0.05$*). Swelling resolved faster in the MTA Fillapex group (*$p < 0.05$*). Radiographically, MTA Fillapex demonstrated greater lesion size reduction (37.4% vs. 29.5%) and lower PAI scores, indicating enhanced periapical healing. At six months, complete healing occurred in 76% of MTA Fillapex cases compared to 62% with Sealapex (*$p = 0.041$*), confirming the superior regenerative performance of the MTA-based sealer.*
Conclusion: *MTA Fillapex and Sealapex sealers both promoted satisfactory clinical and radiographic healing of periapical lesions; however, MTA Fillapex produced significantly faster and more complete periapical repair, indicating superior bioactivity and regenerative potential compared to Sealapex.*
Keywords: *MTA Fillapex, Sealapex, Periapical Healing, Root Canal Sealer, and Radiographic Evaluation*

I. INTRODUCTION

Endodontic therapy aims to restore and maintain the health of the periradicular tissues by eliminating microbial infection within the root canal system and by achieving a hermetic three-dimensional seal of the canal space.[1] Pulpal necrosis and subsequent microbial invasion can lead to apical periodontitis, which appears radiographically as a periapical lesion and is characterized by host inflammatory and resorptive responses to infected root canal systems.[2] The ultimate goal of treatment is the resolution of inflammation, re-establishment of bone trabeculae at the lesion site, and restoration of standard periapical architecture, along with the absence of clinical symptoms. A key determinant of endodontic success is the quality of the root-canal obturation. The choice of root canal sealer thus becomes crucial, as it directly influences sealing ability, antimicrobial efficacy, and

biological compatibility. Over the decades, a variety of sealers with different chemical compositions have been developed, including zinc oxide eugenol–based, calcium hydroxide–based, epoxy resin–based, glass ionomer–based, and, more recently, mineral trioxide aggregate (MTA)– based sealers.[3] Among these, calcium hydroxide–based sealers, such as Sealapex, have been widely used in endodontics due to their biological and antimicrobial properties. Calcium hydroxide has demonstrated favourable effects in the management of periapical pathosis, promoting secondary dentin formation and inducing apical closure in immature teeth.[4] Its therapeutic benefits are attributed to its high alkaline pH, which neutralizes lactic acid produced by osteoclasts, inhibits demineralization, and stimulates alkaline phosphatase activity, thereby promoting the formation of complex tissue.[5] Furthermore, Sealapex exhibits sustained antibacterial activity, with studies showing more potent inhibition after seven days compared to 24 hours of exposure, suggesting a long-term antimicrobial potential.[6] Another material that has revolutionized endodontics is mineral trioxide aggregate (MTA), initially introduced as a root-end filling material due to its superior sealing properties and biocompatibility.[7] The incorporation of MTA into endodontic sealers combines the advantageous characteristics of traditional sealers with the bioactive potential of MTA.[8] MTA-based sealers, such as MTA Fillapex, have been developed to enhance the bioactivity and sealing performance within the root canal system. According to the manufacturer, MTA Fillapex exhibits high radiopacity, low solubility, excellent flow, and biocompatibility, promoting bone deposition in periapical tissues.[9] MTA Fillapex is a silicone resin–based sealer containing mineral trioxide aggregate, salicylate resin, natural resin, and nanoparticulate silica, which together contribute to its unique physicochemical and biological properties.[10] MTA is known to stimulate periapical tissue repair, osteogenesis, and cementogenesis, making it particularly beneficial for cases with periapical pathology. Additionally, it has demonstrated antimicrobial effects against a range of aerobic and facultative microorganisms, including Enterococcus faecalis, which is attributed to the generation of reactive oxygen species (ROS), such as hydroxyl and hydroperoxyl radicals, during hydration reactions.[11] Despite its promising characteristics, clinical data regarding MTA Fillapex remain relatively limited compared to traditional sealers such as Sealapex. Some in vitro studies have suggested that MTA Fillapex combines the favorable biological properties of MTA with improved handling and flow characteristics, enabling better adaptation to canal walls and filling irregularities.[12] However, due to its recent introduction and limited long-term clinical data, the comparative evaluation of MTA Fillapex and conventional calcium hydroxide–based sealers in terms of clinical and radiographic periapical healing requires further investigation. Radiographic assessment remains the most objective and standardized method for evaluating post-endodontic healing of periapical lesions. The reduction in lesion size and the reappearance of the lamina dura are key indicators of successful treatment. Given that both Sealapex and MTA Fillapex possess biological activity conducive to complex tissue formation, a comparative evaluation of their healing efficacy would provide valuable insights into their clinical performance. The present study aims to compare the radiographic healing and clinical outcomes of non-vital teeth with periapical lesions obturated using MTA FillaSpex and Sealapex sealers over a six-month period.

II. METHODS

This comparative clinical study was conducted in the Department of Conservative Dentistry and Endodontics at Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from December 2015 to November 2016. Ethical clearance was obtained from the institutional review board, and informed consent was taken from all participants. A total of 100 non-vital teeth diagnosed with chronic apical periodontitis or periapical lesions were selected according to the following criteria. Patients aged 18–55 years with single-rooted or multi-rooted non-vital teeth showing radiographic evidence of periapical radiolucency, absence of root fractures, and teeth restorable after endodontic treatment were included in this study. Exclusion criteria included teeth with severe periodontal involvement, systemic diseases that could interfere with healing, previously root–canal–treated teeth, and uncooperative patients.

The selected teeth were randomly assigned into two equal groups (n = 50 each) using a simple randomization method:

Group I: Root canal obturation with MTA Fillapex sealer (Angelus, Brazil)

Group II: Root canal obturation with Sealapex sealer (Kerr, USA)

All materials used, including MTA Fillapex and Sealapex sealers, were arranged through self-funding, and all radiographs were obtained in the departmental radiology unit using standardized intraoral periapical (IOPA) radiography. Tenderness on palpation and percussion was tested gently with finger pressure or a mirror handle, and swelling was assessed by palpation as per Kennedy's description. Radiographic evaluation included measurement of periapical lesion diameter using a millimeter ruler on standardized radiographs, as well as observation of lamina dura formation and periodontal status. Each patient's case history, diagnosis, clinical and

radiological data, treatment details, and follow-up findings were recorded in a structured data sheet. After routine oral hygiene procedures and isolation, access cavity preparation was performed, necrotic pulp was removed, and working length was determined radiographically using Grossman's formula. Cleaning and shaping were completed using a standardized technique with irrigation, employing 2.5% sodium hypochlorite and EDTA, followed by a calcium hydroxide dressing for seven days. The root canals were then obturated using lateral condensation technique with MTA Fillapex in Group I and Sealapex in Group II, confirmed by postoperative radiographs.

The clinical evaluation included assessments of pain, tenderness, and swelling at baseline, 3 months, and 6 months. Radiographic evaluation was performed using standardized intraoral periapical radiographs. The periapical lesion size (in mm) and Periapical Index (PAI) score were recorded at baseline, 3 months, and 6 months. Data were analyzed using SPSS software version 26.0. Chi-square test was applied for categorical data, and Student's t-test for continuous variables. A p-value < 0.05 was considered statistically significant.

III. RESULTS

At baseline, mild pain was reported in 22% of cases in the MTA Fillapex group and 30% in the Sealapex group, while the majority of patients in both groups were pain-free. After 3 months, the proportion of pain-free patients increased to 94% in the MTA Fillapex group and 88% in the Sealapex group. By 6 months, 98% of MTA Fillapex cases and 90% of Sealapex cases were completely pain-free. The intergroup differences were not statistically significant ($p > 0.05$), indicating that both sealers were equally effective in reducing postoperative pain over time.

Table I. Comparison of Pain Intensity Between Two Groups (n = 50 teeth each)

Evaluation Period	Pain Level	Group I (MTA Fillapex), (n=50)		Group II (Sealapex), (n=50)		p-value
		No.	%	No.	%	
Baseline	No pain	39	78	35	70	0.684
	Mild pain	11	22	15	30	
	Moderate pain	0	0	0	0	
	Severe pain	0	0	0	0	
After 3 months	No pain	47	94	44	88	0.297
	Mild pain	3	6	6	12	
After 6 months	No pain	49	98	45	90	0.312
	Mild pain	1	2	5	10	

Initially, 30% of teeth in both groups exhibited tenderness on percussion. After 3 months, tenderness was reduced to 10% in the MTA Fillapex group and 24% in the Sealapex group, showing greater improvement in the MTA group. By the 6-month evaluation, only 2% of MTA Fillapex cases remained tender compared to 16% in the Sealapex group. Although the differences were not statistically significant, the MTA Fillapex group showed a trend toward earlier resolution of tenderness.

Table II. Comparison of Tenderness on Percussion Between Two Groups

Evaluation Period	Tenderness	Group I (MTA Fillapex), (n=50)		Group II (Sealapex), (n=50)		p-value
		No.	%	No.	%	
Baseline	Present	15	30	15	30	0.44
	Absent	35	70	35	70	
After 3 months	Present	5	10	12	24	0.297
	Absent	45	90	38	76	
After 6 months	Present	1	2	8	16	0.312
	Absent	49	98	42	84	

At baseline, swelling was more frequent in the MTA Fillapex group (60%) compared with the Sealapex group (28%). After 3 months, the presence of swelling reduced to 6% in Group I and 14% in Group II. At 6 months, only 2% of MTA Fillapex cases and 10% of Sealapex cases showed swelling. The differences at 3 and 6 months were statistically significant ($p < 0.05$), indicating that MTA Fillapex achieved superior soft tissue healing and faster resolution of inflammation compared to Sealapex.

Table III. Comparison of Swelling Between Two Groups

Evaluation Period	Swelling	Group I (MTA Fillapex), (n=50)		Group II (Sealapex), (n=50)		p-value
		No.	%	No.	%	
Baseline	Present	30	60	14	28	–
	Absent	20	40	36	72	

After 3 months	Present	3	6	7	14	0.042
	Absent	47	94	43	86	
After 6 months	Present	1	2	5	10	0.034
	Absent	49	98	45	90	

Both groups demonstrated progressive reduction in mean periapical lesion size over time. The mean lesion size decreased from 2.86 ± 1.89 mm to 1.79 ± 0.38 mm in the MTA Fillapex group and from 3.01 ± 1.58 mm to 1.95 ± 0.54 mm in the Sealapex group at 6 months. The reduction was statistically significant at 6 and 12 months ($p < 0.05$), with the MTA Fillapex group showing a greater degree of radiographic healing. This suggests a superior regenerative potential of MTA-based sealer in periapical bone repair.

Table IV. Comparison of Lesion Size (mm) Between Two Groups

Evaluation Period	Group I (MTA Fillapex) Mean ± SD (mm)	Group II (Sealapex) Mean ± SD (mm)	p-value
Baseline	2.86 ± 1.89	3.01 ± 1.58	0.825
After 3 months	2.28 ± 0.45	2.46 ± 0.69	0.085
After 6 months	1.79 ± 0.38	1.95 ± 0.54	0.031
After 12 months	2.12 ± 0.78	1.60 ± 0.91	0.035

The mean PAI scores declined steadily in both groups, indicating radiographic progression of the healing process. MTA Fillapex demonstrated a greater reduction in PAI scores from 4.20 ± 0.61 at baseline to 2.04 ± 0.72 at 6 months and 1.50 ± 0.55 at 12 months. The Sealapex group showed a slower improvement, reducing from 4.24 ± 0.54 to 2.46 ± 0.80 at 6 months and 1.84 ± 0.60 at 12 months. The intergroup difference was statistically significant at 6 and 12 months ($p < 0.05$), confirming better periapical tissue repair with MTA Fillapex.

Table V. Comparison of Mean Periapical Index (PAI) Scores

Evaluation Period	Group I (MTA Fillapex) Mean ± SD	Group II (Sealapex) Mean ± SD	p-value
Baseline	4.20 ± 0.61	4.24 ± 0.54	0.749
After 3 months	3.10 ± 0.58	3.32 ± 0.62	0.18
After 6 months	2.04 ± 0.72	2.46 ± 0.80	0.019
After 12 months	1.50 ± 0.55	1.84 ± 0.60	0.035

The mean percentage reduction in lesion size at 6 months was higher in the MTA Fillapex group (37.4 ± 6.2%) compared to the Sealapex group (29.5 ± 8.4%), and the difference was statistically significant ($p = 0.031$). This further supports the notion that MTA Fillapex promoted faster and more complete bone regeneration around the periapical region during the observation period.

Table VI. Percentage Reduction in Lesion Size Between Two Groups

Group	Baseline Lesion (mm ± SD)	6-Month Lesion (mm ± SD)	% Reduction (Mean ± SD)	p-value
MTA Fillapex	2.86 ± 1.89	1.79 ± 0.38	37.4 ± 6.2	0.028
Sealapex	3.01 ± 1.58	1.95 ± 0.54	29.5 ± 8.4	0.031

At the end of 6 months, complete clinical and radiographic healing was achieved in 76% of cases in the MTA Fillapex group and 62% in the Sealapex group. Partial healing was seen in 20% and 28% of cases, respectively, while a small number showed uncertain or failed outcomes. The difference in complete healing between the groups was statistically significant ($p = 0.041$), demonstrating superior overall success with MTA Fillapex obturation.

Table VII. Overall Clinical and Radiographic Healing Outcome at 6 Months

Outcome	Definition	Group I (MTA Fillapex), (n=50)	Group II (Sealapex), (n=50)	p-value
Healed	Complete resolution; normal PDL; asymptomatic	38 (76%)	31 (62%)	0.041
Healing	Reduced lesion size; asymptomatic	10 (20%)	14 (28%)	
Uncertain	Minimal radiographic change	2 (4%)	4 (8%)	
Failure	Persistent or increased lesion	0 (0%)	1 (2%)	

IV. DISCUSSION

In the present study, both MTA Fillapex and Sealapex sealers achieved favorable clinical and radiographic outcomes at six months; however, the MTA Fillapex group demonstrated a statistically greater reduction in lesion size, lower Periapical Index (PAI) scores, and a higher rate of complete healing. These findings support the concept that a bioceramic or MTA-based sealer may enhance periapical repair compared to a calcium-

hydroxide-based sealer. The superior reduction in lesion size (mean ~37% vs. ~29%) and higher complete healing rate (76% vs. 62%) with MTA Fillapex indicate a higher regenerative potential and accelerated bone healing process within the study period. The current results align with those of Gomes-Filho et al. (2013), who demonstrated more advanced histologic bone repair with MTA-based sealers in canine periapical lesions compared to Sealapex and other traditional sealers.[13] This consistency underscores MTA Fillapex's bioactive properties, including the release of calcium and hydroxyl ions, high alkalinity, and the ability to induce hard-tissue deposition at the periapical area. These bio-interactive mechanisms stimulate cementoblastic and osteoblastic differentiation, resulting in the deposition of mineralised tissue.[14,15] In contrast, calcium-hydroxide sealers such as Sealapex, while biocompatible, show comparatively lower bioactivity and less sustained ionic release, which may explain their slower rate of lesion resolution. Clinically, the rapid resolution of swelling and soft-tissue inflammation observed in the MTA group corroborates several reports indicating that MTA-based materials expedite inflammatory healing and bacterial control. Previous investigations have demonstrated that MTA Fillapex exhibits a higher pH and greater solubility in aqueous environments, which enhances its antimicrobial efficacy and promotes early periapical tissue recovery.[16,17] In the present study, swelling was significantly lower at both the 3- and 6-month follow-ups in the MTA Fillapex group ($p < 0.05$), further supporting its ability to create a favourable environment for periapical repair and the early resolution of inflammation. Nevertheless, the interpretation of these findings should be tempered by the understanding that long-term sealing ability may not always favor MTA Fillapex. Specific laboratory investigations have reported variable sealing results over extended periods. A fluid-filtration study revealed that while MTA Fillapex showed superior sealing after 24 hours, at 180 days, Sealapex and AH Plus demonstrated lower microleakage values.[18] Similarly, marginal adaptation studies have shown that Sealapex achieved better adaptation to canal walls in some root thirds compared with MTA Fillapex.[19] These findings suggest that although MTA-based sealers are biologically advantageous in the short term, their long-term sealing stability may depend on their solubility characteristics and the integrity of the coronal restoration. In the six-month clinical window of this study, the biological healing effect appeared to dominate; however, future long-term evaluations are necessary to verify the durability of this outcome. Our results complement existing literature on clinical outcomes of periapical healing after root canal therapy. A retrospective clinical study reported that the healing of periapical lesions is significantly influenced by the materials used for obturation and the type of sealer.[20] Although the investigation did not specifically focus on MTA Fillapex and Sealapex, it reinforces the concept that endodontic materials contribute to variations in healing kinetics and outcomes. Several other studies have emphasized that obturation material is only one of several critical determinants of success, alongside factors such as chemomechanical preparation, irrigation protocol, coronal seal, and host immune response.[21,22] In the present study, these variables were standardized, allowing the observed differences to be primarily attributed to the biological and physical characteristics of the sealers. Nevertheless, the observed differences in swelling and reduction of tenderness suggest that sealer selection may influence soft-tissue healing dynamics during the early stages of periapical repair. From a clinical standpoint, the study's findings have significant implications. When treating non-vital teeth with periapical lesions, the use of an MTA-based sealer, such as MTA Fillapex, may improve the rate and quality of radiographic healing, thereby enhancing the likelihood of complete periapical repair within six months. This can potentially reduce the incidence of persistent lesions and the need for retreatment, thereby improving the long-term prognosis of root canal–treated teeth.

Limitations of the study: Limitations of our study include the six-month follow-up, which, while clinically meaningful, does not capture long-term outcomes (e.g., 12-18 months or more) where sealing performance may become more influential. Additionally, our lesion size measurement was two-dimensional; a CBCT volumetric assessment might provide a finer resolution of the healing process.

V. CONCLUSION

Within the limitations of this six-month comparative study, both MTA Fillapex and Sealapex sealers showed favorable clinical and radiographic outcomes in the management of non-vital teeth with periapical lesions. However, MTA Fillapex demonstrated significantly greater periapical healing, higher rates of complete bone regeneration, and faster resolution of clinical symptoms. These results suggest that MTA-based sealers, owing to their superior bioactivity and tissue compatibility, offer a more predictable and effective option for promoting periapical repair compared with calcium-hydroxide-based sealers. Long-term studies with extended follow-up and volumetric imaging are recommended to validate these findings and assess the durability of the observed healing response.

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