The Effect of New Formulations of Hyaluronic Acid Incorporated with MTA on the Repair of Periapical Lesions

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By

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LIST

CONTENTS

No.	Title	Page no.

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

MTA	MTA as retrograde filling
MHM	MTA mixed with Hyaluronic acid used as a retrograde filling
MHJ	MTA used as retrograde filling with injection of hyaluronic acid in the bone cavity

I. INTRODUCTION

Resection of the root end during periradicular surgery results in an exposed apical dentin surface bounded by cementum with a root canal at its center. After

ultrasonic root-end preparation, a root- end filling material is usually placed to seal the root-end cavity preparation.

Complete regeneration of hard tissues after periradicular surgery consists of a renewel of the apical attachment apparatus (dentoalveolar healing) and osseous repair of medullary and cortical bone (alveolar healing). It is thought that undifferentiated mesenchymal cells arise from the periodontal ligament and bone and participate in the healing process.

The ideal root-end filling material should be biocompatible, bactericidal, or at least bacteriostatic; should be neutral to neighboring tissues; and should provide excellent sealing. Furthermore, it should promote regeneration of the original tissues.

A new prospection towards the accelaration of the healing process of the periapical lesions and fastening the new bone formation. For this sake new materials and formulations was used.

The use of Hyaluronic acid in the treatment of inflammatory process is established in many medical areas. In the field of dentistry, hyaluronate has shown anti-inflammatory, antiedematous and anti-bacterial effects for the treatment of gingivitis and periodontitis.

The purpose of this study to evaluate the healing potentiality, sealing ability of new combinations of MTA together with hyaluronic acid.

II.REVIEW OF LITERATURE

I. Physical properties of MTA:

Torabinejad et al (1995) [(1)] determined the setting time, radiopacity and solubility of three commonly used root-end filling material in addition to the newly innovated material mineral trioxide aggregate (MTA). Results revealed that the mean radiopacity of MTA was 7.17 of equivalent aluminum thickness which is more radiopaque than Super-EBA and IRM. Besides that regarding setting time, MTA recorded 2hrs and 45 min(±5min), amalgam recorded 4min(±30sec), IRM recorded 6min(±30sec) and finally Super-EBA recorded 9min(±30sec). Moreover, regarding solubility, no statistical significant difference was found for amalgam, Super-EBA, and MTA when the mean weight of the specimens were compared at different time intervals. Similar significant differences were noted when the mean weight of the specimens were compared at day 7 versus day 21. however except for IRM specimens. None of the tested materials showed any solubility.

Fridland and Rosado (2005) [(2)] evaluated the amount of soluble material released by Mineral Trioxide Aggregate to a water medium, to determine if the solubility differences between specimens of various water/powder ratio and to measure the pH of the water that was in contact with the specimens. Specimens were processed at 0.28 and 0.33 water/powder ratios, and immersed in water according to the ISO 6876 standard. The specimens were periodically removed to assess salt content release and re-immersed in fresh water. Assay testing was periodically performed over a 78-day period. Results were expressed as Daily Solubility (solubility rate), and Cumulative Solubility. Results showed that MTA could solubilize 22.06% at 0.28 water/powder ratio, and 31.095% at 0.33 water/powder ratio of the specimens' mass in regards to their initial dry weight. MTA maintained a high pH for an extended period of time under these study conditions.

Islam and Chng (2006) [3] compared the physical properties**,** namely, P^H, solubility, radiopacity, dimensional changes, setting time, and compressive strength of PMTA, WMTA, ordinary Portland cement (OP) and white Portland cement (WP). These tests were done according to the international organization for standardization (ISO) for dental root canal sealing materials. The setting times and the solubility for each material was measured four times. The radiopacity was measured once and the dimensional changes three times in accordance with ISO 6876:2001. Results showed that PMTA and Portland cement have very similar physical properties. However, the radiopacity of Portland cement is much lower than that of PMTA. The compressive strength of PMTA was greater than Portland cements at 28 days, besides that WMTA also showed significantly greater solubility than the other cements. while there was no significant difference in the solubility of OP and WP, these cements showed greater solubility than PMTA. WMTA and PMTA also showed significantly lesser dimensional change than WP and OP. Given the low cost of Portland cement and similar properties when compared to PMTA, it is reasonable to consider Portland cement as a possible substitute for PMTA in endodontic applications. Methods to improve the setting time and compressive strength may also be explored that may lead to expanded clinical applications of Portland cement

Wiltbank et al (2007) [4] evaluated the effect of selected accelerants on the physical properties of Mineral trioxide aggregate and Portland cement. Classic Portland cement accelerators (calcium chloride, calcium nitrite/nitrate, and calcium formate) were added to gray and white mineral trioxide aggregate (MTA) (GMTA, WMTA) as well as to Portland cement (PC). Time to initially set was measured, as well as dimensional stability, temperature during set, and pH. Results showed that all 3 accelerators significantly accelerated the set of GMTA and PC; only calcium chloride and calcium formate significantly accelerated WMTA. Dimensional stability was not significantly different between control and experimental groups. A statistically significant increase in temperature was observed in one group, but it was

considered insignificant clinically (less than 3 degrees C). There were seemingly minor but statistically significant differences in pH between groups set with calcium nitrite/nitrate and calcium formate.

Storm et al (2008) [(5)] compared the hygroscopic linear setting expansion of GMTA, WMTA and Portland cement with a new device. WMTA differs from GMTA in its lower content of tetracalcium aluminoferrite. Water and powder are mixed in a ratio of 3:1. Each mixture was vibrated into cylindrical mold to avoid the inclusion of air. The MTA samples and mold were covered on one end with either distilled water or Hank's balanced salt solution (HBSS) and allowed to harden at room temperature. Portland cement was only tested under covering with distilled water because it served primarily as a general comparison to previous studies. The mold was constrained so that the displacement caused by linear change could occur only at one end of the mold. To measure the linear setting changes of each specimen. A nylon piston attached to a linear variable displacement transformer was placed on the surface of the setting cement. A computer logged the piston position once per second for 24hrs. The testing apparatus had a resolution of 0.02µm, translating to an accuracy of 0.002% for the 10-mm specimens. Results showed that all the three materials expanded upon setting. Both MTA materials achieved approximately half of their final setting expansion by 300 minutes, with approximately 75% of expansion occurring by 460 minutes (7 hours 40 minutes) and the final 25% of total expansion occurring between 460 minutes and 24 hours. The PC showed much faster expansion, with nearly 80% of total expansion occurring within the first 300 minutes (5 hours). The final steady state linear setting expansion under distilled water covering at (mean-standard deviation) 24 hours was GMTA - 1.02% - 0.19%, PC -0.29%-0.04%, and WMTA-0.08%-0.01%. The linear expansion of all three materials was significantly different from each other. The comparison of final linear setting expansion between GMTA and WMTA covered with HBSS showed a similar significant difference with GMTA-0.68%-0.12% and WMTA-

0.11%-0.03%.A comparison of the final linear expansion between water and HBSS coverings showed a reduction in linear expansion for GMTA that was insignificant (mean water/HBSS- 1.02/0.68) and a small increase in linear expansion for WMTA that was also insignificant (mean water/HBSS -0.08/0.11). Thus it could be concluded that GMTA linear setting expansion was significantly greater than that of WMTA and the Portland cement control. The descending order of expansion was GMTA> PC>WMTA.

Gandolfi et al (2010) [(6)] studied the bioactivity of Proroot MTA as a function of short soaking times in Phosphate solution. The disk samples were prepared and immersed in phosphate containing solution (DPBs) for 10minutes, 5hours, 1and 7days. The cement surface was studied by attenuated total reflectance fourier transform infrared (ATR-FTIR) spectroscopy, by micro-Raman spectroscopy and by environmental scanning electron microscope with energy dispersive X-ray (ESEM-EDX) analyses. Results revealed calcium phosphate bands after 5-hrs immersion in DPBS. After 1 day, an even coating composed of apatite spherulites (0.1-0.8micron diameter) was observed by ESEM/EDX. After 7 days, its thickness had increased. At this time calcium hydroxide was found on the cement surface which was released into the medium that became alkaline. Thus it could be concluded the ability of Proroot to form a superficial layer of apatite within hours. The excellent bioactivity of Proroot MTA provided a significant clinical advantage for root-end or root-perforation repair.

Borges et al (2010) [(7)] determined the water-powder ratio, setting time and solubility and of gray and white structural and non-structural Portland cement, ProRoot MTA and MTA BIO. The water/powder ratio, setting time and solubility were evaluated. Tests followed specification #57 from the American National Standard Institute/ American Dental Association (2000) for endodontic sealing materials. Results showed no statistical difference ($p>0.05$) in the water/powder ratio, among the cements analyzed. Setting time showed statistically significant