J. Int Oral Health 2011

A comparative evaluation of the sealing ability of Mineral Trioxide Aggregate, High Copper Silver Amalgam, Conventional Glass Ionomer Cement, and Glass Cermet as root end filling materials by dye penetration method

Sharada HL* Biji Briget*

*M.D.S, Senior Lecturer, Department of Conservative Dentistry and Endodontics, Government Dental College and Research Institute, Bangalore, India.
Contact: bijibrigit@yahoo.com

Abstract:
Objective: The Purpose of this investigation was to assess the effectiveness of Mineral Trioxide Aggregate in providing an apical seal in comparison with High Copper Silver Amalgam, Conventional Glass Ionomer Cement Type 2, and Glass Cermet cement by using a dye penetration method.
Methods: The root canals of seventy extracted teeth were instrumented and obturated with gutta-percha. Each tooth was apically resected and the apex was prepared ultrasonically to 3mm depth. Teeth were divided randomly into four groups of 15 each. First group was retro filled with high copper silver amalgam, second group with conventional glass ionomer cement type 2, third group with ketac silver and the fourth group with mineral trioxide aggregate. Following immersion in India Ink the roots were demineralised and the depth of dye penetration was evaluated by a stereomicroscope at 12× magnification.
Results: 66.7% of the specimens filled with High Copper Silver Amalgam, 46.7% of the specimens filled with Ketac Silver, and 20% of the specimens filled with Conventional Glass Ionomer showed severe dye leakage (more than 3mm). None of the specimens in group 1V (Mineral Trioxide Aggregate) showed

P- ISSN
0976 – 7428

E- ISSN
0976 – 1799

Journal of International Oral Health

Conservative and Endodontics

Original Research

Received: Oct, 2010
Accepted: Jan, 2011

Bibliographic listing:
EBSCO Publishing
Database, Index Copernicus, Genamics Journalseek Database, Proquest, Open J Gate.

severe leakage. 53.3% of the specimen's retrofilled with Mineral Trioxide Aggregate showed no microleakage. The Fisher Exact Test revealed a statistically significant difference between Mineral Trioxide Aggregate with High Copper Silver Amalgam, Ketac Silver, and Conventional Glass Ionomer Cement ($p<0.05$). **Conclusion:** Mineral Trioxide Aggregate provided a better seal; further studies are needed to determine the suitability of this material for in vivo use.

Key words: Mineral Trioxide Aggregate, Microleakage, Biocompatibility

Introduction:

The objectives of modern endodontic therapy are to clean, shape and fill the root canal system in order to remove all the organic material and sealing the root canal with a three dimensional obturation

Endodontic therapy can be by non-surgical or surgical method. The goal of periradicular surgery is to gain access to the affected area, remove the diseased tissue, and place a biocompatible seal, in the form of root end filling that can stimulate regeneration of the periodontium. The formation of new cementum on the surgically exposed root surface and on the root end filling material is essential to the regeneration of the periodontium. The characteristics of an ideal apical root end filling material include adherence to dentinal walls of the retrograde cavity preparation, periradicular tissue tolerance and bioactive promotion of healing. [1]

Mineral Trioxide Aggregate has been claimed to seal off all the pathways between the root canal and periradicular tissues. Therefore, it would be of academic and clinical interest to compare the apical seal provided by MTA with the existing root end filling materials.

1. To evaluate the apical sealing ability and compare of Mineral Trioxide Aggregate as a root end filling materials.
2. To compare the apical sealing ability of Mineral Trioxide Aggregate, High Copper Silver Amalgam, Glass ionomer cement and Glass Cermet as root end filling material.

Materials and method:

Source of data

The present in vitro study was conducted in the Department Of Conservative Dentistry and Endodontics, Government Dental College and Research Institute, Bangalore. Seventy freshly extracted human maxillary single rooted anterior teeth were selected based on the inclusion and exclusion criteria. Infection control protocol for collected extracted teeth, their storage and handling was done according to guidelines recommended by occupational safety and health administration (OSHA) and the center for disease control (CDC).

Materials

Normal Saline (0.9% W/V Sodium Chloride, Core Health Care Limited). 5.25% Sodium Hypochlorite (Dentfills, Bhandup (W), Mumbai, India). 15% Ethylene Diamine Tetra Acetic Acid Plus 10% Urea Peroxide (RC Prep Jar, Premier Dental Products Co, Premier Dental, Canada).Pro Root MTA (Densply Maillefer, Ch-B 1338 Ballaigues, Switzerland). Ketac Silver (3M ESPN AG. Germany). Ketac Easy Mix (Glass Ionomer Filling Material) (ESPE AG Germany). DPI Alloy (Non Gamma 2 Amalgam) (The Bombay Burmah Trading Corporation, Ltd India,). Gutta Percha Points (Densply). AH Plus Sealer. (Densply Detrey Gmbh. Germany). India Ink. 5% Nitric Acid. 98.8 Methyl Alcohol. Methyl Salicylate

Armamentarium

Airotor Hand Piece (Trend, Tc- 95bc, W&H, Austria). Micro Motor Hand Piece. Ultrasonic Retro Tip (Satelac).Tapered fissure bur (ISO 012. Brasseler USA, Savannah, GA, USA). K. Files (Densply). Finger Spreaders. Round Diamond Point (No. 001, F. G. 10, Horico Diamond Instruments, Germany).Tapering Diamond Point (NO. 170, F.G. 12, Horico Diamond Instruments,

Germany). Sterile Absorbent Points. Tweezers. Scale. Scissors. Disposable Syringes.

Hand Pluggers. Ball Burnisher. Mixing Pad and Spatula. Gates Glidden Drills (Rtd, 3 Rue Louis Neel, 3810, Stegreve, France)
Equipments: Stereomicroscope

Methodology:

The in vitro study samples comprised of seventy intact freshly extracted human permanent maxillary anterior teeth, Standard access cavities were prepared. All the teeth used in this study had single root canal. The crowns were removed 3mm above the cemento enamel junction using high-speed diamond points with air water spray coolant at a plane perpendicular to the long axis of the tooth. All the samples were subjected to standard endodontic root canal treatment. The coronal access sealed with Glass ionomer cement. The apical 3mm of each root was resected using a high speed tapered fissured bur under water spray at approximately 90% to the long axis of the tooth. Retrograde cavities of 3 mm were made using ultrasonic retro tip. The prepared cavities were randomly divided into four groups, each group containing 15 teeth each. GROUP 1- Retro filled with High Copper Silver Amalgam with Cavity Varnish. GROUP 2- Retro filled with conventional Glass Ionomer Type II after conditioning the preparation with 10% polyacrylic acid solution. GROUP 3- Retro filled with Ketac Silver. GROUP 4- Retrofilled with Mineral Trioxide Aggregate.

All roots were covered with two layers of sticky wax to within 2mm of the apical preparation. The remaining root surface was carefully coated with finger nail polish so that only the retro filling material remained exposed. The control roots were prepared in a similar manner. However, in the positive control group no nail polish was coated on the unfilled retrograde preparations, in the negative controls; the unfilled preparations were completely covered with the nail polish. All roots were stored for 7 days in 100% humidity at room temperature. (By dipping in oasis)

The roots were placed in India ink for 72 hours, rinsed with tap water, and the wax and fingernail polish were completely removed. The following technique was then used to clear the teeth. The roots were demineralised by placing them in 5% nitric acid for 5 days with daily changes of the acid. After rinsing with tap water, the roots were dehydrated by placing in 99.8 % methyl alcohol for 3 days with daily changes of the alcohol. Finally, the roots were stored in methyl salicylate to complete the clearing process. The degree of ink penetration was determined by three evaluators using stereomicroscope at X 12 power. Each root was individually scored as Score 0 - no microleakage, Score 1- mild microleakage, Score 2- moderate microleakage, Score 3 – severe microleakage. Score1- Dye penetration involving less than half of the retrograde cavity depth, Score 2- Dye penetration involving entire depth of the retrograde cavity, but not the cavity floor, Score 3- Dye penetration involving deeper than the retrograde cavity and floor. The data were compared statistically using a Fisher Exact Test with a level of probability set at $p < 0.05$.

Results:

All tested materials leaked. But the maximum leakage 100% was observed in-group I and group III. 86.7% of micro leakage was observed in-group II. The minimum leakage of 53.3% was observed in-group IV.When comparing group 1V (Mineral Trioxide Aggregate) and group 1 (High Copper Silver Amalgam), 11 (Conventional Glass Ionomer), and 111, (Ketac Silver) it is found to be statistically significant (P=0.00002**).

Discussion:

The requirements of an ideal root end filling material are well documented. For many years Silver Amalgam has been accepted as the material of choice for retro fillings in

endodontic surgery, its continued use has been questioned for reasons such as leakage, biocompatibility, corrosion, staining of hard and soft tissues[4]. Silver Amalgam root end fillings leaked with high dye leakage scores, and statistically significant difference in the apical microleakage between the Silver Amalgam and Conventional Glass Ionomer Cement ($p<0.05$).[6] It also agrees (Torabinjed, 1993[2] et al and J. Aqrabawi, 2000)[7] that Mineral Trioxide Aggregate leaked significantly less than Silver Amalgam ($p<0.0007$) when used as a retrofilling material. The use of Glass Ionomer cement leaked significantly more than Mineral Trioxide Aggregate. However; to achieve the chemical bonding to the tooth structure it is essential to avoid moisture. The conditions under which this investigation was performed made it possible to avoid moisture contamination during handling of the material. In clinical setting it will be a major problem to be dealt with. The results of the study indicate that Silver Reinforced Glass Ionomer leaked more than Conventional Glass Ionomer Cement and Mineral Trioxide Aggregate, however it leaked less than High Copper Silver Amalgam. (Al –Ajam and McGregor et al).[10]

Several in vitro studies have investigated the sealing ability of Mineral Trioxide Aggregate using fluorescent dye and confocal microscopy (Torabinjed M et al 1993) methylene blue, (Torabinjed M et al 1994) and bacterial marker (Torabinjed M et al 1995), all reported good results with Mineral Trioxide Aggregate when ranked with other materials.

Conclusion:

Based on the above findings it can be concluded that Mineral Trioxide Aggregate offers significant scope as a retrofilling material. The direct extrapolation of the results of this study to clinical situation can be made only after further in vivo investigations are undertaken.

References:

1. Stephen Cohen, Kennath M. Hargreaves. Pathways of the Pulp. 9th edition.
2. Mohmoud Torabinejad, TF Watson, TR Pittford. Sealing ability of a mineral trioxide aggregate when used a root end filling material. Journal of Endodontics 1993; 19: 591-4.
3. Bus San Chong, Thomas R, Pitt ford. Root end filling materials: rationale and tissue response. Endodontic topics 2005; 11: 114-30.
4. CHJ Hauman, RM Love. Biocompatibility of dental materials used in contemporary endodontic therapy: a review. Part 2. Root-canal filling materials. International Endodontic Journal 2003; 36: 147-60.
5. Frank J Vertucci, Richard G beattty. Apical leakage associated with retrofilling techniques. A dye study. Journal of Endodontics 1986; 12: 331-6.
6. BS Chong, TR Pitt Ford, TF Watson. The adaptation and sealing ability of light –cured glass ionomer retrograde root fillings. International Endodontic Journal 1991; 24: 223-32.
7. Mohmoud Torabinejad, Akbar Falah Rastegar, James D. Kettering, Thomas R, Pitt Ford. Bacterial leakage of mineral trioxide aggregate as a root end filling material. Journal of Endodontics 1995; 21: 109-12.
8. L Zetterqvist, Anneroth G, Danin J, Roding K. Microleakage of retrograde fillings-a comparative investigation between amalgam and glass ionomer in vitro. International Endodontic Journal 1988; 21:1-8.
9. Wu M-K, Kontakiotis E G, Wesselink P R. Long term seal provided by some root end filling materials. Journal of Endodontics 1985; 59: 82-7.
10. Al-Ajam AD, McGregor AJ. Comparison of the sealing abilities of ketac- silver and extra high copper alloy amalgam when used as retrograde root canal filling. Journal of Endodontics 1993; 19: 353-6.

11. Oslon AK, Mac Pherson MG, Hartwell GR, Weller N. Kullid JC. An in vitro evaluation of injectable thermoplastic gutta percha, glass ionomer, and amalgam when used as retrofilling materials. Journal of Endodontics1990; 16: 361-4.

Source of Support: Nil

Conflict of Interest: No Financial Conflict