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Research Article

COMPARISON OF THE SEALING ABILITY OF MTA ANGELUS, BIODENTINE AND RESIN MODIFIED GIC AS A FURCAL PERFORATION REPAIR MATERIAL UNDER THE OPERATING MICROSCOPE: AN IN-VITRO STUDY

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A B S T R A C T

Objective: The aim of this study was to compare sealing ability of the MTA angelus, Biodentine and RMGIC when used to repair the furcal perforations in permanent molars using stereomicroscope.

Material And Method: 30 extracted permanent molars were selected. Access cavities were made using a #5 round bur. Perforations were made in the centre of the floor of the pulp chamber using a round bur. The teeth were randomly assigned into 1 control and 3 experimental groups based on a material used to seal perforations. Group 1- control group, Group 2-MTA Angelus, Group 3-Biodentine, Group 4-RMGIC.The packed materials were allowed to set for 24 hour in the incubator. The samples were sectioned longitudinally and linear dye penetration was measured from apical end of the perforation to the pulp chamber floor using stereomicroscope. kruskal-wallis test was used for statistical analysis using SPSS software.

Results: The difference in the mean length of dye penetration between groups was statistically significant. The pair wise comparison was done between the groups using Mann-Whitney U test as post hoc analysis, which reveals the difference between Group 1 and all other group was statistically significant ($p \leq 0.05$) and also Group 2 and Group 3 at ($p \leq 0.05$).However, statistically highly significant difference was seen between Group 3 and Group 4

Conclusion: All materials showed micro leakage when assesed under microscope however the least microleakage was seen in case of biodentine which is statistically significant

INTRODUCTION

The primary aim of the root canal treatment is to prevent apical periodontitis which is a consequence of bacterial contamination within the root canal system. Thus, the success of endodontic treatment is highly dependent on the prevention of recontamination of root canal space following disinfection.. Adequate shaping, irrigation, and hermetic seal of the root canal system are indispensable steps to achieve this goal..In endodontic practice procedural accidents are encountered that will affect the prognosis of root canal treatment. one of these procedural accidents is endodontic perforation[1] ,these are the mishaps that might occur during the course of endodontic treatment mainly due to iatrogenic factors.However, they might also occur due to extensive decay of dentinal structure.[1] Ingle JL reported root canal perforation as the 2nd most common cause of endodontic failures as it accounted to 9.6% of all unsuccessful cases [2] Furcal perforation is taken into account as associate undesirable procedural incident that affects prognosis of the root canal treatment., it is an artificial communication between the pulp chamber and the supporting structures of the tooth through the floor of the pulp chamber.

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Furcal perforations are caused by numerous reasons such as misdirection of the bur while preparing access cavity, carious involvement, and restorations. Delaying the repair of perforation can lead to inflammmation, periradicular breakdown and ultimate loss of the tooth, gingival attachment and bone[3,4].

A furcal perforation can be repaired using non surgical or a surgical approach. However, a surgical approach is less prefered due to difficulty in obtaining accessibility to repair and also it leads to loss of attactment, pocket formation. Therefore non surgical coronal approach is recommended which involves the immediate placement of the repair material in the perforation to avoid potential bacterial infection of wound site[5].

Prognosis of the perforation repair depends on site, size, time of repair and material used for sealing the perforation[6].Different repair materials such as zinc oxide eugenol, glass ionomers cement, amalgam, IRM has been used in the past[7].Ideally a perforation repair material should be biocompatible, well sealing, non resorbable, radiopaque and bacteriostatic[8].Since large furcal perforations acts as a bottomless pit, the extrusion of repair material is unavoidable during perforation repair through coronal access[9]. Moreover, large furcal perforations are difficult to completely seal off with a repair materials due to their size and extent. Therefore, a material used for the repair of large furcal perforation should be biocompatible with shorter setting time and good sealing ability [9,10].

Mineral trioxide aggregate (MTA) is calcium silicate based cement used widely as a apical barrier for open apex, pulp capping, pulpotomy, root end filling,root canal filling,resorption and perforation repair material due to its antimicrobial, tissue biocompatibility, sealing ability and radiopaque[11,12].

It is available in commercial forms such as Pro-Root MTA (Dentsply, Swizweland) and MTA Angelus (Angelus, Londrina, Brazil) (Fig 1)[13].However, MTA Angelus is preferred for the repair of the furcal perforations due to shorter setting time and better handling properties ([14,15]. Biodentine (Septodont, France) (Fig 2) is another calcium silicate based repair material widely used as a material for pulp capping, pulpotomy, root end filling, dentin substitute, root canal filling, apex closure and furcal perforation repair material. It has good handling, biological, mechanical and physical properties[16] .GIC is widely used as restorative material in conservative dentistry for luting, for restoration (esthetic and reinforced), orthodontic treatment, cavity base and buildups. Due to lack of moisture sensitivity, low mechanical strength and impaired translucency. RMGIC cement were introduced by adding polymerizable hydrophillic resin to GIC. RMGIC has been used as dentin substitute as it forms a bond with the tooth which aids in obtaining an honest seal.

Even though there have been studies comparing MTA with other calcium silicate based materials, there is sparse data comparing the sealing ability of MTA-Angelus, Biodentine and RMGIC under operating microscope[17].Operating microscope provides better visualization which results into better marginal adaptation of the material. Hence this study was conducted to compare the sealing ability of MTA-Angelus, Biodentine and RMGIC when used as repair materials for furcal perforations, under operating microscope.

MATERIAL AND METHOD

Sixty freshly extracted human mandibular molars with closed apex and completely distinct roots were selected(Fig 3). Teeth with cracks, caries, or resorption were excluded from the study. Teeth were cleaned and stored in 5.25% Naocl for 24 hours to disinfect the sample. The samples were stored in normal saline solution until used for the study.

The teeth were decoronated 4mm above the CEJ and roots were horizontally cutoff in the mid root(Fig 4). A standardized access cavity was prepared in each tooth using a diamond bur(#0.5 round bur). Pulp tissue was removed by stainless steel Barbed broach and was irrigated with the normal saline.The orifices and apical portion were sealed by resin composite Tetric N-flow Bulk Fill (Ivoclar vivadent,Mumbai).

A perforation was made with a size (#2) round carbide bur in a high speed aerotor hand piece in the centre of the pulp chamber floor. The bur was replaced after every 6 perforations. The width of all perforations was similar, but the length of the perforation depended on the dentin-cementum thickness from pulp chamber to furcation area. All samples were observed under the operating microscope(cricdental, India) at x10 magnification.

The samples were randomly divided into a control group (perforation without repair n=15) and 3 experimental groups (n=15) and based on repair materials MTA, Biodentine and RMGIC.

Group 1 - control group (perforation without repair)
Group 2 - MTA was applied into the perforation site and compacted with the moist cotton pellets (Fig 5)
Group 3 - Biodentine was applied into the perforation site and compacted with the moist cotton pellets (Fig 6)
Group 4 - RMGIC was applied into the perforation site and compacted with the moist cotton pellets(Fig 7)

The teeth were placed in a thermocycling device for 2 days (5 cycles) in order to simulate the oral cavity.

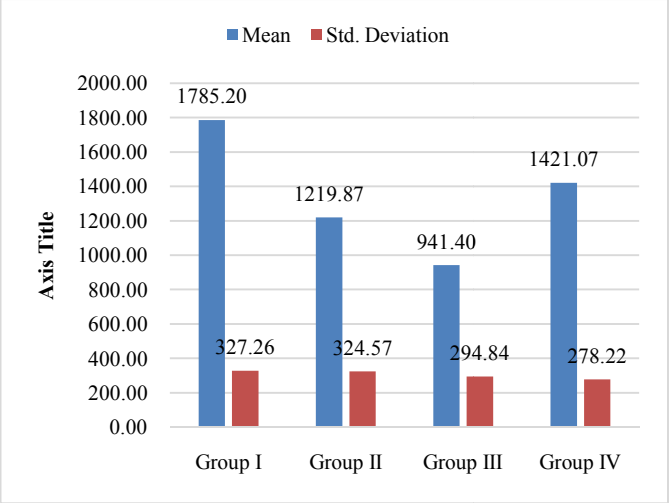
Teeth were restored with composite and covered with 2 layers of nail polish except 1mm around the perforated area so that the dye would only penetrate through the furcation area.All teeth were immersed in 2% methylene blue for 24 Hr and rinsed with water to remove the dye. Samples were sectioned mesiodistally parallel to long axis and linear dye penetration was measured on each wall from the apical end of the perforation to the pulp chamber floor with the image Pro express software using a stereomicroscope at x10 magnification.

Statistical Analysis

Data were statistically analyzed using Kruskal-Walls test to compare the mean length of micro leakage between different groups followed by Mann-Whitney test as post hoc analysis.

The statistical analysis was performed using SPSS for windows version 22.0

RESULTS



	N	Mean	Std. Deviation	F	p	Inference
Group I	15	1785.20	327.26	20.06	0.0001 (<0.001)	Highly significant
Group II	15	1219.87	324.57			
Group III	15	941.40	294.84			
Group IV	15	1421.07	278.22			

	Group II	Group III	Group IV
Group I	565.33*	843.8*	364.13*
Group II		278.46*	-201.2*
Group III			-479.66*

*Indicates that the difference in the mean is significant at 0.05 level.

- Statistically significant difference was seen between Grp 1 (control) and all other groups. ($p<0.05$)
- Statistically significant difference was seen between Group 2 MTA and Group 3 BIODENTINE. ($p<0.05$)
- Statistically highly significant difference was seen between Group 3 BIODENTINE and Group 4 RMGIC. ($p<0.05$)
- Mean and standard deviations were calculated for all groups.
- Data was analyed using SPSS software using two way ANOVA test and multiple comparison was done using Post-hoc Tukey's test. ($p<0.05$)

Fig 1 MTA Angelus (Angelus,Londrina,Brazil)

Fig 2 Biodentine (Septodont,France)

Fig 3 Sixty teeth were selected for study

Fig 4 The teeth were decoronated 4mm above the CEJ

Fig 5 MTA was applied into the perforation site and compacted with the moist cotton pellets

Fig 6 Biodentine was applied into the perforation site and compacted with the moist cotton pellets

Fig 7 RMGIC was applied into the perforation site and compacted with the moist cotton pellets

DISCUSSION

Iatrogenic perforations will complicate the treatment and compromise the prognosis if it is not managed properly[18].Factors that affects the prognosis of perforation repair includes the level, location and size of perforation, the time delay before perforation repair and the material used for sealing the perforation. Previously, GIC was used for perforation repair as it has been used as a dentin substitute it forms a chemical bond with tooth which aids in obtaining a good seal. However, In study did by Sakshi Hegde, the marginal seal is compromised with GIC and it exhibits maximum microleakage this is due to technique sensitivity and dissolution of GIC due to exposure to tissue fluids.The results of this study are in accordance with it as RMGIC is shown to exhibit least sealing ability among the three repair materials.

MTA is reported to exhibit favorable sealing property due to cementogenic activity as it releases calcium ions which interact with phosphate groups in surrounding tissue fluids to form hydroxyapetite on its surface[19].In this study GIC showed higher leakage than MTA followed by Biodentine ,but according to Tonny *et al* (2019) there were no statistical difference in the sealing ability of MTA and Biodentine when employed for repair of a large furcal area.

However, the study conducted by Brito Junior *et al* MTA exhibited 70% leakage within 20 days .The findings of present study are in accordance with this study[20].

It was hypothesized that the shorter setting of MTA may prevent it from having good wetting and adaptations to walls of defect[21].

Biodentine is recommended as a perforation repair material because it has good mechanical strength and is biocompatible and bioactive[22].It has better handling properties and shorter setting time compared to MTA[23].

In this study though there is statistical difference, Biodentine showed lesser leakage compared to MTA Angelus. It is due to to the ability of biodentine to form and precipitate hydroxyapetite[24].It is also capable of inter tubular diffusion and formation of mineral tags of hydration products leading to hybrid zone formation with dentine[25].

According to a study by Gussenar MB *et al*, Biodentine showed significantly higher push out bond strength than MTA when used as root perforation repair materials. Moreover, Biodentine shows better interlocking with dentine compared to MTA because of its smaller particle size and uniform components[26].

The main prognotic factor in the management of a furcal perforation is time lapse between its occurrence and repair. Therefore, immediate repair of a furcal perforation is important for endodontic success.

However, profuse bleeding from the perforation site would limit the clinician from immediate sealing with the conventional restorative materials.

Since this study was carried on extracted teeth there was no bleeding, no pain as well as saliva which affects the sealing ability of these materials. Therefore, it is clinically relevant to evaluate and compare sealing ability of these materials.

CONCLUSION

Within the limitations of this study, it can be concluded that

- All the materials showed microleakage when assessed under the microscope for the dye penetration.
- However, the least microleakage was seen in case of biodentine, which was statistically significant.

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