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Comparison of White MTA And Grey MTA in the Apical Sealing Ability of Lased And Unlased Root Canal Walls - A Pilot Study

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Abstract
Objective: *To evaluate and compare the effect of marginal adaptation of White Mineral trioxide aggregate (MTA) and Grey mineral trioxide aggregate (MTA) in lased and unlased canal walls.*
Methodology: *Twenty extracted teeth were divided into group A and group B with 10 teeth in each group. Group I uses white MTA and Group II uses grey MTA as barrier material. Two groups were subdivided into A and B with 5 teeth in each group. After creating a divergent open apex conventional root canal treatment was performed in all the teeth and obturated 5mm short of apex. In group IA and group IIA lasing of the canals with810nm Ga Al As diode laser was performed before placement of white and grey MTA respectively.Remaining two groups were sealed with white MTA and grey MTA without lasing. Teeth were sectioned and examined under SEM at 1000x magnification to check the width of the gap.*
Results: *Mean width of the gap between lased specimens was found to be 0.392µm and that of unlased specimens was found to be 2.82µm respectively. The difference between the mean width was found to be statistically significant with a p value<.05*
Conclusion: *Among the barrier materials grey MTA showed better adaptation than white MTA. Lasing the canals prior to the placement of the barrier material has improved its marginaladaptation.*
Keywords: *White MTA, Grey MTA, Diode Laser, Image J software*

I. Introduction

Incomplete root development caused by trauma, caries or other pulpal pathosis requires special attention and treatment. The aim is to seal a sizeable communication between the root canal system and periradicular tissue and provide a barrier against which obturation material can be compacted. The main objective of root end filling materials is to provide an apical seal that prevents movement of bacteria and the diffusion of bacterial products from root canal system into periapical tissues. An ideal barrier material should adhere to the preparation walls forming a tight seal in the root canal system. These materials should be non-toxic, non-carcinogenic and biocompatible with host tissues, it should be insoluble in tissue fluids and dimensionally stable. In addition it should be easy to manipulate ,fast setting and radiopaque, further the presence of moisture should not affect their sealing ability Within the past ten years MTA, GIC, composite resins, resin glass ionomer hybrids(Geristore), zinc oxide eugenol cements (IRM, SuperEBA) are few of the materials that are common in clinical use as barrier materials. With the introduction of lasers to the field of conservative dentistry, endodontic treatment was enriched by multitude of new treatment methods that improved the chances for a successful treatment outcome. Lasers were shown to be feasible and effective tools for cleaning and disinfecting the root canal system, particularly because they helped to overcome the problem of insufficient depth of penetration of commonly used disinfecting agents. The effects of laser irradiation on dental hard tissues may cause chemical, thermal, and / or mechanical changes. Several studies on the impact of different laser systems on the root canal and the surrounding dentin have been published. Laser systems such as Nd:YAG and CO_2 lasers have proved to be very effective in cleaning and disinfecting the root canal wall and the lateral dentinal tubules, which are not fully accessible in conventional treatment and can be considered a reservoir for microorganisms. With the great progresses in the field of laser technology, semiconductor lasers such as diode laser are gaining increasing importance. Studies of the morphological changes of root canal wall after irradiation with diode laser proved that, the diode laser is useful for removing smear layer and debris from root canal walls, and reducing apical leakage after obturation in vitro and suggest that it would be useful for root canal treatment. The purpose of the study was to find out whether the marginal adaptation of root end filling materials can be enhanced by irradiating the canal walls with diode laser prior to the placement of root end filling materials. This helps in obtaining a hermetic seal in the apex thus improving the treatment outcome. [1, 2]

II. Materials and Methods

Freshly extracted, intact, non-carious, single rooted premolars extracted for orthodontic reasons were selected. Teeth were examined with radiographs for canal configuration, calcification, any other developmental defects etc. Twenty premolars were selected devoid of bifurcation, canal calcification and developmental defects.

Teeth were resected apically by 2mm and divergent open apex created with gates glidden drill. Samples were then divided into two groups – Group I and Group II with ten teeth in each group. Group I was assigned for white MTA and Group II for grey MTA Root canal treatment were performed as per standard endodontic protocol 5 mm short of apex. Groups were subdivided into A and B with five teeth in each group and lasing of the canals with 810nm GaAlAs Diode Laser,1.5W continuous wave 2sec/mm of length of the root × 4 times was done in GROUP IA and GROUP II A prior to the placement of White MTA and Grey MTA respectively.

Specimens were then split longitudinally using a slow speed diamond saw under water cooling. Apical 5mm were resected, dried, and mounted on an aluminum stub, sputter-coated with gold and assessed under SEM at 1000x magnification. Equidistant apical and coronal points were selected on right and left margins of the samples. Width of the gaps between MTA and root dentin were measured using Image J software and values recorded. Statistical analysis was carried with paired t-tests and two way ANOVA.

III. Results

The SEM observations were shown in Table 1,2,3,4 & 5 and Figures 1,2,3,4.

SEM observations revealed the existence of gaps between the root dentin and the barrier material in both Group I and Group II samples. Width of the gap was found to be comparatively lesser in lased samples than that of unlased ones.

Mean width of the gap between lased specimens was found to be 0.392µm and that of unlased specimens was found to be 2.82µm respectively. The difference between the mean width was found to be statistically significant with a p value<.05. Comparing Grey and White MTA samples a better marginal adaptation was showed by Grey MTA (mean=1.258um) than White MTA (mean=1.986um)

IV. Discussion

Success of endodontic treatment and periapical surgical procedures can be derived to a great extent from the creation of a fluid tight seal of the root canal and the apical root dentin. Many Attempts were made to seal apical foramen using CO2 lasers following removal of pulp and disinfection of the canals. [3]

Recrystallization of apical root dentin was demonstrated by applying CO2 laser to the apices of freshly extracted human teeth (Miserendino L.L in 1988)

In vitro studies using Nd:YAG laser have shown a reduction in penetration of dye or bacteria through resected roots. This was probably due to the result of structural changes in dentin like melting, solidification and recrystallization of the hard tissue. Efforts have been made to improve the marginal adaptation of retrofilling material. Nd:YAG and diode laser irradiation leads to the sealing of apical dentinal tubules .This sealing effect can be utilized during periapical surgeries as well as in conventional obturation techniques. [4,5]

Nd:YAG lasers widely used in root canal procedures , showed many structural changes in root dentin including disruption of smear layer, dentine coalescence, covering the RC surface with a recrystallised glazed layer. These factors could be a cause for the reduction in dentine permeability which in turn improved the quality of the apical seal produced. [6,7,8]

Another factor that improved adaptation of Grey MTA than White MTA be the higher setting expansion of Grey MTA compared to White MTA. [9,10,11]

V. Conclusion

With these results it can be concluded that lasing the canals prior to the placement of the barrier material has improved its marginal adaptation. Among the barrier materials Grey MTA showed better adaptation than White MTA. Among the lased samples though Grey MTA samples showed slightly better adaption the values were not statistically significant. The present study opens interesting aspects in the fields of laser assisted endodontics. Further studies with a larger number of samples have to be conducted to acquire additional information.

FIGURES:

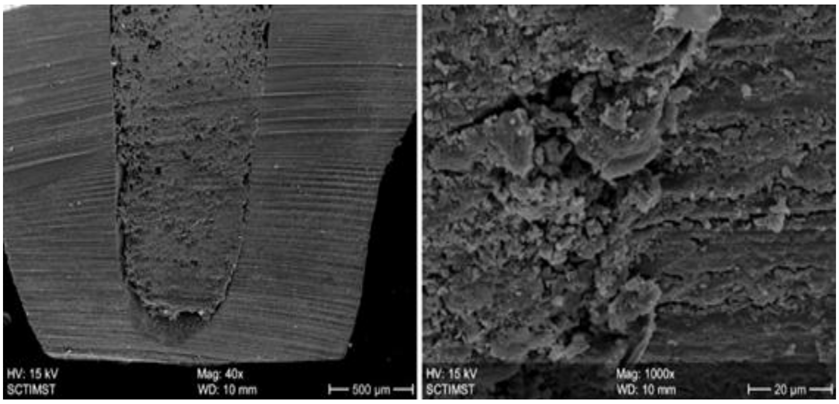

Figure1 – SEM view of Group IA

Specimen	Group	Subgroup	Apical Right (μm)	Apical Left (μm)	Coronal right (μm)	Coronal Left (μm)

Figure2 – SEM view of Group IB

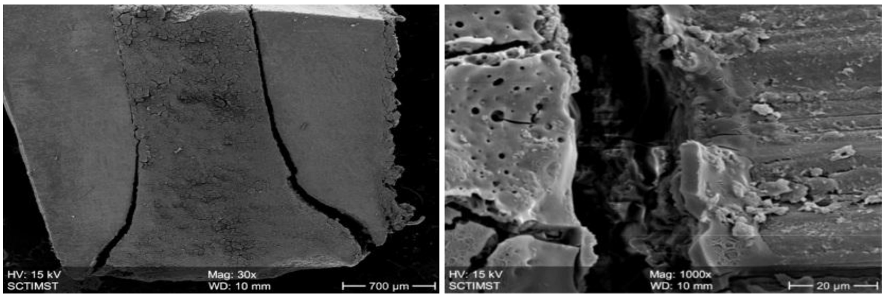

Figure3 – SEM view of Group IIA

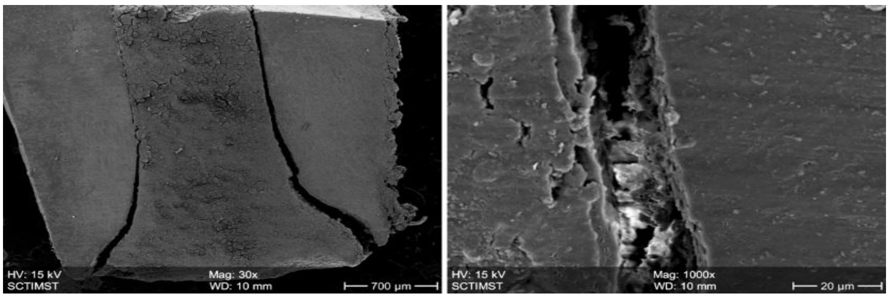

Figure4 – SEM view of Group II B

TABLES

Table 1-Marginal Gap in apical and coronal area of Specimens in SEM evaluation

LWMTA	I	A	0.17	0.14	0.12	0.14
LWMTA	I	A	0.09	0.09	0.050	0.04
LWMTA	I	A	0.15	0.09	0.13	0.08
LWMTA	I	A	0.1	0.12	0.09	0.14
UWMTA	I	B	1	2	1.4	2.2
UWMTA	I	B	1.08	0.8	0.9	0.7
UWMTA	I	B	0.5	0.4	0.4	0.4
UWMTA	I	B	0.9	1.04	0.7	1
UWMTA	I	B	0.6	0.8	0.4	0.5
LGMTA	II	A	0.12	0.16	0.12	0.14
LGMTA	II	A	0.07	0.06	0.03	0.04
LGMTA	II	A	0.15	0.02	0.06	0.04
LGMTA	II	A	0.13	0.12	0.14	0.13
LGMTA	II	A	0.07	0.06	0.05	0.07
UGMTA	II	B	0.8	0.5	0.8	0.5
UGMTA	II	B	0.6	0.5	0.7	0.4
UGMTA	II	B	0.32	0.34	0.43	0.2
UGMTA	II	B	0.52	0.74	0.63	0.82
UGMTA	II	B	0.41	0.82	0.3	0.51

table-2 T test group statistics

	Group	**N**	**Mean**	**Std. Deviation**
Apical Rt	White MTA	10	.4680	.40466
	Grey MTA	10	.3140	.25334
Apical Lt	White MTA	10	.554	.6239
	Grey MTA	10	.322	.2849
Coronal Rt	White MTA	10	.4330	.44305
	Grey MTA	10	.3200	.29002
Coronal Lt	White MTA	10	.5310	.66497
	Grey MTA	10	.3020	.25659

Table 3 - Independent Samples Test

t-test for Equality of Means				
		T	Df	Sig. (2-tailed)
Apical Rt	Equal variances assumed	1.020	18	0.321
Aprical Lt	Equal variances assumed	1.070	18	0.299
Coronal Rt	Equal variances assumed	.675	18	0.508
Coronal Lt	Equal variances assumed	1.016	18	0.323

Table-4 T-Test Group Statistics

Location	Specimen	N	Mean	Std. Deviation
Apical Rt	Lased	10	.1140	.03534
	Unlased	10	.6680	.26335
Aprical Lt	Lased	10	.092	.0388
	Unlased	10	.784	.4825
Coronal Rt	Lased	10	.0930	.04218
	Unlased	10	.6600	.32728
Coronal Lt	Lased	10	.0930	.04398
	Unlased	10	.7400	.55015

Table-5 Independent Samples Test

-test for Equality of Means				
		T	Df	Sig. (2-tailed)
Apical Rt	Equal variances assumed	-6.593	18	.000
Aprical Lt	Equal variances assumed	-4.521	18	.000
Coronal Rt	Equal variances assumed	-5.434	18	.000

Coronal Lt	Equal variances assumed	-3.707	18	.002

Table-6 Tests of Between-Subjects Effec

Dependent Variable

Source	Type III Sum of Squares	df	Mean	F	Sig.	Partial Eta
Corrected Model	1.754[a]	3	.585	22.487	.000	.808
Intercept	3.058	1	3.058	117.601	.000	.880
Group	.119	1	.119	4.561	.049	.222
Laced	1.535	1	1.535	59.022	.000	.787
group * laced	.101	1	.101	3.878	.067	.195
Error	.416	16	.026			
Total	5.228	20				
Corrected Total	2.170	19				