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RESEARCH ARTICLE

"SEALING ABILITY OF MTA ANGELUS, BIODENTIN , GERISTORE-AN ULTRAVIOLET SPECTROPHOTOMETRIC ANALYSIS".

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Abstract

Aim:-The objective of this in vitro was to assess the sealing ability of MTA Angelus, Geristore®, and Biodentin to repair furcation perforations in mandibular and maxillary molars by using spectrophotometric analysis.

Materials and methods: Fourty eight mandibular or maxillary molars were randomly divided into four experimental groups. Fourty eight teeth with perforation were used including a control group with perforation repair. Furcal perforations were made in the teeth with small round bur from the pulpal floor. Perforations were repaired with MTA Angelus in Group I, and Biodentin in Group II, Geristore in Group III, a control GroupIV , All samples were stored similarly for 48 hr. Each tooth was stored in a vial containing 5 ml of concentration nitric acid for 3 days. The solutions thus obtained were centrifuged at 3500 rpm for 5 min. Four milliliters of the supernatant liquid was then analyzed in an ultraviolet (UV) visible spectrophotometer at 550 nm wavelength with concentrated nitric acid as the blank and readings were recorded as absorbance units.

Result: Comparison of microleakage using one way ANOVA test shows that the mean value of GROUP IV (0.149833) is highest followed by GROUP III(0.076083),GROUP I(0.059583) least in GROUP II(0.0395).

Conclusion:Biodentin have shown better sealing ability in furcal perforation in comparison to MTA Angelus and Geristore.

Introduction:-

Perforation can be defined as mechanical or pathological communication between the root canal system and the external tooth surface. A furcation perforation is one such complication that refers to mid-curvature opening into the

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periodontal ligament (PDL) space and leads to worst possible treatment outcome. According to Seltzer, perforations were the second greatest cause of failure in endodontic therapy. Ideal endodontic repair material should seal the pathways of communication between the root canal system and its surrounding tissues. In addition, it should be nontoxic, noncarcinogenic, nongenotoxic, biocompatible, insoluble in tissue fluids, and dimensionally stable. The repair of perforation defects can be achieved using different materials, this include amalgam , calcium hydroxide, Gic, zinc phosphate cement,resin modified Gic, indium foil, gutta-percha,light cured composite and calcium enriched matrix cement, however none of these materials were able to re establish the normal architecture in perforation , therefore there is a necessity for introduction of newer materials. Most preferred furcation repair materials are bioactive materials like Mineral Trioxide Aggregate, Biodentine.

Geristore has been recommended both as a root-end filling material, and in restoring sub gingival surface defects such as root-surface caries and iatrogenic perforations.

The purpose of the study is to compare the sealing ability of Mta angelus, Biodentine and Geristore with dye extraction method using ultraviolet spectrophotometric analysis.

Materials And Methods:-

40 extracted maxillary or mandibular molars will be selected. The teeth were stored in 3% sodium hypochlorite until further use. Molars were decoronated 3 mm above the cemento-enamel junction and roots were amputated 3 mm below the furcation. A standardized endodontic access opening was prepared in all 40 samples.Sticky wax was placed over the orifice of each canal. It was then coated with two layers of nail varnish. To ensure each perforation was centered between the roots, a black marker pen was used to mark the location of the defect.A defect 1 mm in diameter was made from the external surface of the tooth with a number 2 round carbide bur mounted on a high-speed handpiece with air water coolant. The chamber and perforation were flushed with water and dried. The teeth were kept in an incubator at 37°C for 24 h for simulating clinical conditions.

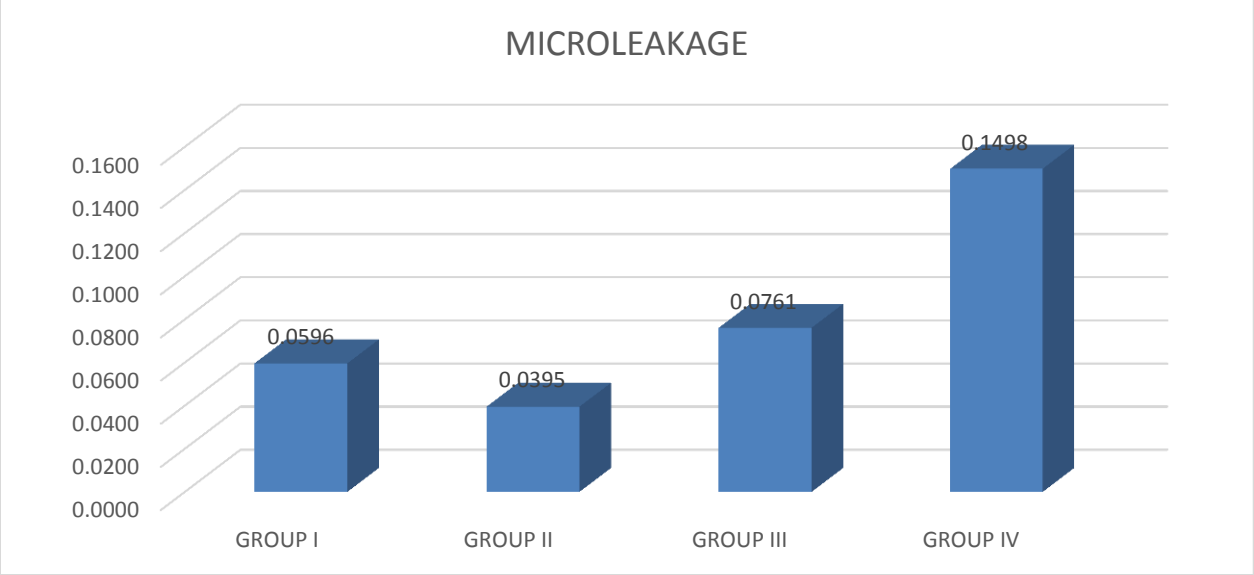
Teeth were randomly divided into four groups.
Group i- mta angelus (10 each)
Group ii- biodentine(10 each)
Group iii- geristore (10 each)
Group iv- control(10 each)

Each group was placed in separate Petri dishes containing 2% methylene blue such that all teeth were immersed in dye up to the cemento-enamel junction for retrograde dye challenge and dye was added to access chamber of each teeth so that it was filled for orthograde dye challenge. All samples were stored similarly for 48 hr. After removal of the dye, teeth were rinsed under tap water for 30 min and varnish removed with a polishing disc. Each tooth was stored in a vial containing 5 ml of concentration nitric acid for 3 days. The solutions thus obtained were centrifuged at 3500 rpm for 5 min. Four milliliters of the supernatant liquid was then analyzed in an ultraviolet (UV) visible spectrophotometer at 550 nm wavelength with concentrated nitric acid as the blank and readings were recorded as absorbance units. The obtained readings were statistically analyzed using one-way analysis of variance and Tukey multiple comparisons tests.

Statistical Analysis:-
One Way Anova With Posthoc Tukey Test For Comparison Of The Microleakage

		N	Mean	Std. Deviation	Statistics/ mean squares	df2(welch) / F(Anova)	p value
MICROLEAKAGE	GROUP I	12	0.059583	0.011301	91.734	21.982	**≤0.001**
	GROUP II	12	0.0395	0.005792			
	GROUP III	12	0.076083	0.014576			
	GROUP IV	12	0.149833	0.024079			
	Total	4	0.08125	0.044675			

		8					



Posthoc Tukey Test

Dependent Variable	COMPARISON GROUP	COMPARED WITH	MEAN DIFFERENCE	Std. Error	P VALUE
MICROLEAKAGE	GROUP I	GROUP II	.0200833*	0.006303	**0.014**
		GROUP III	-0.0165	0.006303	0.056
		GROUP IV	-.0902500*	0.006303	**≤0.001**
	GROUP II	GROUP III	-.0365833*	0.006303	**≤0.001**
		GROUP IV	-.1103333*	0.006303	**≤0.001**
	GROUP III	GROUP IV	-.0737500*	0.006303	**≤0.001**

Result:-

Comparison of microleakage using one way anova test shows that the mean value of GROUP IV (0.149833) is highest followed by GROUP III(0.076083),GROUP I(0.059583) least in group ii(0.0395). This difference is statistically significant with a test value of 21.982 and p value of <0.001. Post hoc tukey test shows that the difference between GROUP I and GROUP II is statistically significant with a mean difference of .0200833* and p value of 0.014.The difference between GROUP I and GROUP III is not statistically significant with a mean difference of -0.0165 and p value of 0.056. the difference between GROUP I and GROUP IV is statistically significant with a mean difference of -.0902500* and p value of <0.001. the difference between GROUP II and GROUP III is statistically significant with a mean difference of -.0365833* and p value of <0.001. the difference between GROUP II and GROUP IV is statistically significant with a mean difference of -.1103333* and p value of <0.001. The difference between GROUP III and GROUP IV is statistically significant with a mean difference of -.0737500* and p value of <0.001.

Discussion:-

The principle goal of an endodontic therapy is to remove microbes and seal the root canal system effectively. Inadvertent perforation interferes with this goal because of damage to the periodontal attachment apparatus and

subsequent bacterial proliferation. Perforations can be successfully managed with the use of a nonsurgical coronal approach by immediate placement of the reparative material in the perforation to prevent bacterial infection[9].
Long term success of a perforation repair is related to several factors among which the foremost is the biocompatibility of the material and ability of repair material to provide an adequate seal. The perforation of pulpal floor into the furcation area of posterior teeth may occur iatrogenically due to inadequate knowledge of the pulp chamber anatomy, tooth malalignment or failure to consider anatomic variations. The calcification of the pulp chamber as a consequence of aging, trauma or other irritants may increase the risk of perforation during access and location of canal orifices. Non-iatrogenic causes of furcation perforation include internal resorption and dental caries. Furthermore moisture, bleeding, unconventional access and repair of perforation a complicated procedure[10].

Dye-extraction provides more reliable results than dye penetration study because of its ability to measures all of the dye taken up in the root. The dye-extraction technique is as good as fluid filtration technique because it also takes into account all of the porosities of the interfaces between the filling material and the root.Technique are based on quantitative measurements of the passage of a liquid within these interfaces[11].

MTA is a mixture of a refined Portland cement, bismuth oxide and gypsum and is reported to contain trace amounts of Silicon dioxide, Calcium oxide, Megnesium oxide, potassium sulphate, and sodium sulphate . MTA has been extensively used as perforation repair material due to its reported favorable sealing ability, biocompatibility and dentinogenic activity[12].

Biodentine is a bioactive , dentine substitute specifically designed as a "dentine replacement" material.
The powder component of the material consists of tricalcium silicate, dicalcium silicate, calcium carbonate and oxide filler, iron oxide shade, and zirconium oxide. Tricalcium silicate and dicalcium silicate are indicated as main and second core materials, respectively, whereas zirconium oxide serves as a radiopacifier. The liquid, on the other hand, contains calcium chloride as an accelerator and a hydrosoluble polymer that serves as a water reducing agent and fast setting time.

The setting period of the material is as short as 9–12 minutes. This shorter setting time is an improvement compared to other calcium silicate materials. The material is characterized by the release of calcium when in solution like MTA.

MTA was suggested as a repairing material in furcal perforation . MTA has excellent marginal adaptation to the external borders of the perforation sites. The main disadvantage of MTA is the time required for initial setting which makes this material inappropriate for repairing transgingival defects. If the material is in contact with oral fluids, it will be washed out of defective site before setting. Therefore a more rapid-setting resin ionomer, such as Geristore is recommend in such cases .

Geristore has been recommended both as a root-end filling material, and in restoring sub gingival surface defects such as root-surface caries and iatrogenic perforations[13].

Geristore is used for surgical repair of root perforations and as an adjunct to guided-tissue regeneration. Geristore is less sensitive to moisture rather than conventional Glass-Ionomer cement. Dry environment will improve the results of Geristore usage[14].

Geristore introduced by Den-Mat Corporation, USA, is a hydrophilic, nonaqueous, polyacid-modified composite resin composed of fluoride-releasing glass (barium, fluorosilicate) and a polymerizable organic matrix combined with a photoinitiator. The reported advantages of resin ionomers are increased adhesion to tooth structure, insolubility in oral fluids, dual cure potential, low polymerization shrinkage, low coefficient of thermal expansion, radiopacity, release of fluoride, self-adhesive nature (no need for retentive cavity design), and biocompatibility.

Studies have indicated that Geristore is biocompatible and has great clinical success, when used in the repair of subosseous and subgingival defects and in guided tissue regeneration. Results of observational studies evaluating the effect of various root-end filling materials on gingival fibroblast cells showed greater cell attachment to Geristore as compared to MTA. Other *in vivo* studies indicate that in comparison to intermediate restorative material (IRM), glass ionomer cement and MTA Geristore are less cytotoxic to gingival fibroblasts

Geristore in furcal perforation repair is the effect of acid-etching and irrigation on the Bioglass which may lead to washing out of this matrix. Definitely in most cases, some material remained in the cavity borders and these remnants seemed to prevent effective chemical bonding of Geristore to dentin and therefore reduce the sealing ability of Geristore[15]. It seems that the high sealing ability of Geristore might be related to the chemical bonding of this material, acid-etching and bonding applying before the material placement which will definitely improve its sealing ability (Dragoo, 1997).

Geristore under three different environments also showed no significant change. This might be due to the fact that Geristore is self-adhesive with low polymerization shrinkage and has a low co-efficient of thermal expansion that provides excellent marginal integrity, and also it is hydrophilic and bonds in the presence of moisture and blood.

Dye penetration technique has long been used in endodontics because of its ease of performance and difficulty of other available techniques. Dye extraction methodology was employed in this study, which according to Camps J and Pashley gave similar results to the fluid – filtration technique as both are based on quantitative measurements of liquid passage within interfaces[16]. An ultraviolet spectrophotometry was adopted since it is widely used technique because of its rapid analysis and the cost of the analysis is less expensive.

Ultraviolet-visible spectrophotometry refers to absorption spectroscopy or reflectance spectroscopy in the ultraviolet-visible spectral region. This means, it uses light in the visible and adjacent (near-UV and near- infrared) ranges. The absorption or reflectance in the visible range directly affects the perceived color of the chemicals involved.

Biodentin was introduced by Gilles and Olivier in 2010.It is available in powder and liquid form. The powder consists of tricalcium silicate as the main core material, dicalcium silicate as the second core material, calcium carbonate oxide which acts as a filler, iron oxide as a coloring agent and zirconium oxide which acts as a radio-opacifier[17].

Liquid consists of calcium chloride as an accelerator and hydrosoluble polymer which acts as water reducing agent. It is a fast-setting calcium silicate based restorative material recommended for use as a dentin substitute that can be used as a coronal restoration material for perforation repair.

Biodentine bonds chemomechanically with the tooth and composite. This has high compressive and flexural strength. Biodentine can induce the synthesis of a dentin-like matrix by human odontoblast-like cells in the form of mineralization nodules that have the molecular characteristics of dentine[18].

This material can also stimulate cell growth and induces Hydroxyapatites (HA) formation on the surface of the material when exposed to simulated body fluid[19]. HA have been shown to induce bone formation, growth, and maintenance at the bone material interface[20].

The thickness of the calcium and silicon-rich layers increased over time, and the thickness of the calcium and silicon-rich layer was significantly larger in biodentine compared to MTA after 30 and 90 days, concluding that the dentine element uptake was greater for Biodentine than for MTA[21].

The biomineralization ability of Biodentine, most likely through the formation of tags, greater calcium and silicon uptake from adjacent root canal dentine and least microleakage when compared with other retrograde filling materials are the probable reasons for its least dye absorbance.

Biodentine had a significantly higher push-out bond strength than MTA after 24 h setting time. After 7 days, MTA and Biodentine had similar push-out bond strength in uncontaminated samples. Blood contamination had no effect on the push-out bond strength of Biodentine, irrespective of the duration of setting time[22].

Comparison of MICROLEAKAGE using one way ANOVA test shows that the mean value of GROUP IV (0.149833) is highest followed by GROUP III(0.076083),GROUP I(0.059583) least in GROUP II(0.0395) . The difference between GROUP I and GROUP III is not statistically significant with a mean difference of -0.0165 and p value of 0.056.

Conclusion:-

Within the limitations of this study, it was observed that Biodentin showed better sealing ability in furcation repair when compared with other repair materials like Mineral Trioxide Aggregate Angelus and Geristore. There is no statistical difference between MTA Angelus and Geristore.

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