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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/12763
DOI URL: http://dx.doi.org/10.21474/IJAR01/12763

RESEARCH ARTICLE

COMPARATIVE EFFECT OF SELF VS DUAL CURING ON ANTIBACTERIAL PROPERTY IN A NOVEL DENTAL RESTORATIVE MATERIAL- AN INVITRO STUDY

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Manuscript Info

Manuscript History
Received: 20 February 2021
Final Accepted: 24 March 2021
Published: April 2021

Key words:-
Cention-N, Antibacterial Efficacy, Modified Direct Contact Test, Self Cure, Light Cure, S.Mutans

Abstract

Aim: To evaluate and compare the antibacterial efficacy of Cention-N in two different curing methods.
Methods: Twenty blocks of Cention-N were prepared according to standard manufacturer's instructions and were divided into two groups- self cured and light cured (ten blocks in each group). Streptococcus mutans were extracted from dental caries by a series of biochemical treatments and strains of S.mutans were treated with both groups of Cention-N blocks.
Results: Self cured Cention-N blocks exhibited statistically significant reduction in bacterial colonies compared to Light-cured blocks.
Conclusion: Additional light curing inhibits the antibacterial efficacy of Cention-N cement.

Introduction:-

Dental caries is a multifactorial disease which causes destruction of organic tissues and demineralization of inorganic tissues by metabolites produced by microorganisms. Streptococcus mutans constitutes the major microbial population in dental caries.

Dental restorations play a vital role in arresting the progression of dental caries. From amalgam to resin cements, each restoration has its own strength, longevity, durability, esthetics, bonding to the tooth and ease of use. However studies indicate that no dental cement has been shown to form a perfect seal with the tooth structure. This causes micro leakage which eventually leads to the formation of secondary caries (1) which is attributed as one of the major causes of failure of dental restorations. (2).

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In order to reduce further pulpal inflammation from bacteria, there has become a need for cements which can bond much better to the tooth structure and also possess antibacterial activity (3, 4).Numerous studies have been done to assess the antimicrobial activity of different cements (5). Antibacterial activity is achieved by the fluoride which is incorporated in modern day restorative materials. Anti-caries effect of fluoride occurs through several mechanisms- reduces the solubility of enamel by converting hydroxyapatite into less soluble fluorapatite, reduces the ability of plaque organisms to produce acid and promotes remineralization of enamel which has been decalcified.(6)

Since dentists have long sought after a cost effective, fluoride releasing, easy to use, high strength and esthetic material(7,8), Cention-N has been introduced.

Cention-N is a basic, resin based, self-curing restorative material. It is an alkasite restorative material which is classified as a subgroup of composite resin which utilizes alkaline filler for releasing acid-neutralizing ions (9).

Cention-N is self-curing with optional light curing. Light curing can be done with blue light in the wavelength of approximately 400-500 nm, thus enabling all standard polymerization lights to cure the material. In this study we wanted to compare the antibacterial effect of Cention-N as a self-cured and a light cured, thereby analyzing which method has more effective antibacterial activity (10).

Methodology:-

The in-vitro study was conducted in the Department of Conservative Dentistry and Endodontics and Department of Microbiology at Krishnadevaraya College of Dental Sciences, Bangalore.

Cention-N blocks were made by mixing the powder and liquid according to manufacturer's instructionsand poured into round celluloid bands to form blocks measuring 5mm in diameter and 3mm in height each.Out of the 20 prepared blocks, 10 blocks were segregated and subjected to light curing for 20 seconds. These blocks were sterilized by rinsing them with 70% alcohol for 10 seconds (11).

The samples were processed by Direct Contact Test which is based on determining the turbidity of microbial growth in microplates. Caries was excavated from a single decayed tooth and transferred to 5ml sterile brain heart infusion (BHI) broth, vortexed for 1 minute and 50 µl of broth was transferred onto a sterile mitis salivarious bacitracin agar and incubated in a candle extension jar for 24 hrs at 37ºC.Colonies of S.mutans were segregated by gram staining and biochemical tests.

20µl of the extracted S.mutans were inoculated into 5ml of BHI broth in sterile ependorf tubes and incubated at 37ºc for 4 hrs.(Twenty such medium were kept ready).The culture was adjusted to Mcfarland standard. The blocks were transferred to each of tubes under aseptic condition and 1 ml of sterile BHI broth was added.

After 24 hours, the culture from each ependorf tube was transferred to 5ml sterile BHI broth, vortexed for 1 minute and 50 µl of broth was transferred onto a sterile mitis salivarious bacitracin agar in petri dishes and incubated in a candle extension jar for 24 hours at 37ºC .Colonies of S.mutans were counted by "direct counting method" which includes microscopic counts using a hemocytometer.

Fig 1.1 : Cention N


Fig 1.2 : Cention N blocks

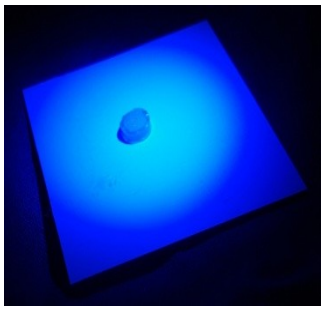
Fig 1.3 : Light curing

Results:-

Fig 2.1:- Self cured sample

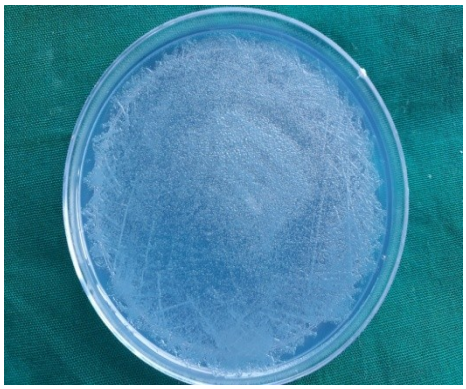

Fig 2.2:- Light cured sample.

The numbers within each group were summed up and statistical analysis was done as depicted in the following table. Comparison of anti-microbial activity between the study groups was done by assessing p value.

	N	Mean	SD	Mean Difference (95% CI)	t	df	p-value
Self Cure	10	84480	7107.55	31840 (23191.86-40488.14)	7.74	18	<0.001*
Light Cure	10	116320	10905.33				

Self cured samples showed greater reduction of bacterial colonies compared to light cured samples. The mean difference at 95% confidence interval (CI) was found to be 31840, giving the P value of <0.001, which is statistically significant.

Discussion:-

In this study S.mutans was used for the whole experiment because of its proven etiology in caries development. By excavating caries from one source (single tooth) the bias in the microbial environment has been controlled.

Direct Contact Test (DCT) has been used in this study because it relies on direct and close contact with the microbes and the restorative material, and is independent of the diffusion properties (5).This makes it more suitable for testing restorative materials and cements.DCT also simulates the clinical situation more, where the cement comes in contact with the cariogenic microbes. The bactericidal effect of the cement instead of bacteriostatic effect was measured as described in the Modified Direct Contact Test method by Zhang et al (2009).

Fluoride which plays an important role in anticariogenic activity, gets incorporated in enamel in the form of reserves which is then released at low pH and inhibits acid production (12). At low pH and under glucose excess, the accumulation of biofilms of S.mutans on fluoride-bound hydroxyapatite crystals is also reduced (13). The growth of S.mutans is inhibited by fluoride, which acts on the bacterial glucose uptake and glycolysis pathways (14).

The rate at which fluoride is released varies with respect to storage media, temperature, contact area and powder/liquid ratio (15). It increases in acidic conditions (demineralising solution) especially in organic acids (16, 17).

Numerous studies have been done to assess the fluoride efficacy in self and dual cure methods. A study conducted by Yoda et al has demonstrated that the rate and amount of fluoride released (from fluoridated cements) is influenced by the curing method and storage medium (18). Self curing increases the resin matrix permeability which in turn leads to increased fluoride release. Light curing enhances immediate bonding to tooth structures. However, polymerization with light activation increases cross linking density and network quality thereby reducing the permeability of fluoride ion release. (19, 20)

Cention-N consists of barium aluminum-silicate glass filler, ytterbium trifluoride, calcium barium aluminum fluorosilicate glass filler, an isofiller which is made using Tetric N-Ceram technology and calcium fluorosilicate (alkaline) glass filler. Cention-N is resistant to degradation because the fillers are surface modified. When the powder and liquid are mixed, Cention N constitutes inorganic filler of 78.4% weight and alkaline glass of 24.6% weight in the final material and this releases considerable amount of fluoride ions. When the cement comes in contact with the tooth surface, the hydroxide ion of the hydroxyapatite crystal can be exchanged by the fluoride released from the cement thus forming fluorapatite (6).

Cention-N also prevents demineralization of the tooth by releasing hydroxide and calcium (OH- and Ca2+) ions. The hydroxide ions create an environment which reduces excess acidity caused by the cariogenic bacterial activity. Cention-N exhibits a sustained release of fluoride and hydroxyl ions below critical pH even though there are no enough studies to claim this proof.

Cention N contains the photoinitiator Ivocerin, a dibenzoyl germanium derivative. Ivocerin absorbs the photons from the curing light causing dissolution of the chemical bonds in the initiator molecule and releases two radicals, which then reacts with the monomer and thereby creates a polymer network (9). When Cention-N is light cured, complete polymerization occurs which results in a tightly bound or less hydrophilic matrix and this in turn releases less fluoride ions (21). More the fluoride ions greater the bactericidal effect, hence self cured Cention-N which releases more fluoride ions has more anticariogenic activity compared to light cure.

Conclusion:-

All the test materials exhibited antibacterial efficacy against S. mutans but to varying degrees. Self cured Cention-N blocks were more effective as compared to light cured blocks. Therefore anticariogenic activity of Cention-N can be increased by reducing the use of light cure.

Financial Support:
Nil.

Conflicts Of Interest:
There are no conflicts of interest.

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