ISSN 2063-5346 *Section A-Research paper*

EFFECT OF THREE GENRES OF MOUTH RINSES ON THE COLOUR STABILITY OF AESTHETIC RESTORATIVE MATERIALS WIDELY USED IN PEDIATRIC DENTISTRY

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ABSTRACT

BACKGROUND: A growing concern for children's social development is aesthetics. In order to satisfy patients'aesthetic needs, tooth-coloured restorative materials have been widely used; however, occasionally, discolouration may occur, leaving parents and patients unhappy.Although oral rinses are frequentlyused to support periodontal health, regular use might cause discolouration. Many herbal mouthwashes are becoming more and more popular because they don't contain alcohol, dyes, or artificial components. AIM: The study was to evaluate effect of three genres of mouth rinses on the colour stability of aesthetic restorative materials widely used in pediatric dentistry. METHODOLOGY: Three types of mouth-rinses(Listerine, Hiora, and tulsi extract) and three restorative materials were used in this study (GIC, RMGIC and Giomer). Ninety disc shaped specimens, thirty from each restorative material were made in prefabricated celluloid mould with dimensions of 10*2mm.All specimens were stored in artificial saliva at 37˚C for 24 hours in an incubator. The initial colour values were recorded with spectrophotometer according to CIELAB scale. After baseline evaluation, the specimens were divided into 3 subgroups, according to the testing and control storage solutions (n=30). Randomly selected specimens from each material were immersed in 20 ml of the treatment solutions at 37˚c for 24 hours. Each specimen was then subjected to second colour measurement. The collected data was statistically analyzed using two-

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way analysis of variance (ANOVA) and Tukey's HSD at a significance level of 0.05. RESULT AND CONCLUSION: Tulsi based mouthrinse caused the highest discolouration and Hiora K caused the lowest. The highest colour change occurred to Giomer and GIC affected theleast.

KEYWORDS: Mouthrinse, tooth coloured restorations, discolouration.

INTRODUCTION

The development of numerous tooth-coloured restorative materials as a result of rising aesthetic standards in dentistry has made a variety of materials available for clinical usage.[1] Achieving a number of factors, including the replication of tooth shape and shade as well as the maintenance of the chosen colour over the functional lifetime of the restoration in a dynamic oral environment, are necessary for an aesthetic dental restoration to be effective.[2] Since mouthwashes have anti-inflammatory, antibacterial, and analgesic effects, they are frequently used to promote and stabilise periodontal health. However, prolonged mouthwash usage might harm restorations and soft tissues.[1]Because they function without alcohol or dyes and have substances that are found in nature, several herbal mouthwashes are becoming more and more popular. Tulsi is referred as "The Incomparable One,""Mother Medicine of Nature," and "The Queen of Herbs," in Ayurveda and it is regarded as a "elixir of life" that has no equivalent for both its therapeutic and spiritual qualities. Tulsi is used in India in a variety of spiritual rites and daily routines that offer a wide range of health advantages that modern science is only now beginning to prove.[3]When it comes to aesthetic restorative materials, fluoride release and adhesion to both enamel and dentin were two distinct features that glass ionomer cements (GICs) originally demonstrated in the 1970s. However, colour instability was a significant flaw with traditional GICs. As a result, various hybrid restorative materials, including resin-modified glass ionomer cement (RMGIC) and poly-acid modified glass ionomer, such as Giomer, were created to enhance the materials' physical and aesthetically pleasing qualities. The advantages of both resin composites and glass ionomers are combined in these materials, yet they act more like resin composites.[4]The three most significant characteristics for any restorative material's longevity are colour stability, surface roughness and surface micro hardness. Plaque deposition and material staining are both impacted by rough surface structure, which also lowers material quality.[5] Additionally, because the oral cavity is exposed to various solutions on a daily basis, the surfaces of dental restorations may change or become stained. Hence,

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we conducted a study to evaluate the effect of three genres of mouthrinses on the colour stability of aesthetic restorative materials widely used in Pediatric Dentistry.

MATERIALS AND METHOD

- Three restorative materials:

a) Glass Ionomer Cement (Ketac molar, 3M ESPE)

b) Resin Modified GIC (Fuji II LC, GC International Corp., Tokyo,Japan)

c) Giomer (Beautiful II, SHOFU INC., Kyoto, Japan)

- Three mouth rinses :

a) Listerine (Johnson&Johnson Inc., USA)

b) Hiora k (The himalayan drug company)

c) Tulsi extract based mouthrinse

- Artificial saliva as control group

METHODOLOGY

Three restorative materials (RMGIC, GIC, and Giomer) and three mouthwashes (Listerine, Hiora, and tulsi extract) described in table 1 and 2 were employed in this experiment. Artificial saliva was used as the control group. In a premade celluloid mould with dimensions of 10*2mm, 90 disc-shaped specimens were created, with thirty from each restorative material. The DentGist Light Curing Machine (Premium Cordless LED Light Cure Unit) was used to light-cure the restorative materials in the moulds for 20 seconds on each side. To allow for post-polymerization, all specimens were kept in artificial saliva at 37 °C for 24 hours. The initial colour values (L*, a*, and b*) for each specimen were measured and recorded using a spectrophotometer (VITA Easyshade Advance®) in the basic shade measuring mode before the samples were placed in the treatment solutions.The degree of colour shift was measured using the CIELAB system, a three-dimensional colour space, which measures colour brightness as a* and b*, or red-green (a*) and blue-yellow

(b*), respectively. Following a baseline assessment, the specimens were split into three subgroups based on the testing solutions (n=30). Specimens from each material were submerged in 20 ml of the treatment solutions at 37 °C for 24 hours, which is comparable to 2 minutes per day for two years of mouthrinsing. Specimens were stored in a dark place. Specimens were removed after 24 hours and cleaned with running water. Each specimen was then dried before undergoing a second colour assessment.

– The total colour difference ΔE* was calculated using following formula:

$\Delta E^* = (\Delta L^{*2} + \Delta a^{*2} + \Delta b^{*2})1/2$

– The collected data was statistically analyzed using two-way analysis of variance (ANOVA) to evaluate the effects of the material type and mouth-rinse on colour changes, and Tukey's HSD (Honestly Significant Differences) between the means when ANOVA test was significant. The level of significance was primarily set as 0.05 in all tests.[4]

Preparation of Tulsi extract :

The dried leaves of tulsi were ground into a fine powder. The powder was then soaked in 100 percent ethanol and filtered afterwards in wathman filter paper. 200 g of tulsi powder were dissolved in 1 L of ethanol to produce 12 grams of tulsi extract (residue 4% w/w).[6]

Material	Composition	Manufacture
Beautiful II (Nano-hybrid resin based Giomer material)	Matrix: 16.7wt% of resin (Bis-GMA and TEGDMA). Filler structure: Surface Pre-ReactedFluoroboroaluminosilicate Glass Filler, Nano Filler, MultiFluoroboroaluminosilicate Glass Filler (68.6vol% and 83.3wt%)	SHOFU INC., Kyoto, Japan
Fuji II LC (resinmodified glass ionomer)	Powder: Fluoroaluminosilicate glass Liquid: acrylic acid, maleic acid, HEMA, water, comphorquinon Filler content: 76% by weight, 55% by vol.	GC International Corp., Tokyo,Japan
	Powder: Silica - 41.9% Alumina - 28.6 Almunium flouride - 1.6% Calcium flouride - 15.7	3M ESPE

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Ketac molar (glass ionomer restorative material)	Sodium flouride - 9.3% Almunium Phosphate - 3 % Liquid - Polyacrylic acid - 35% Tartaric Acid - 5-1 % Water	

Table 1 composition of restorative materials

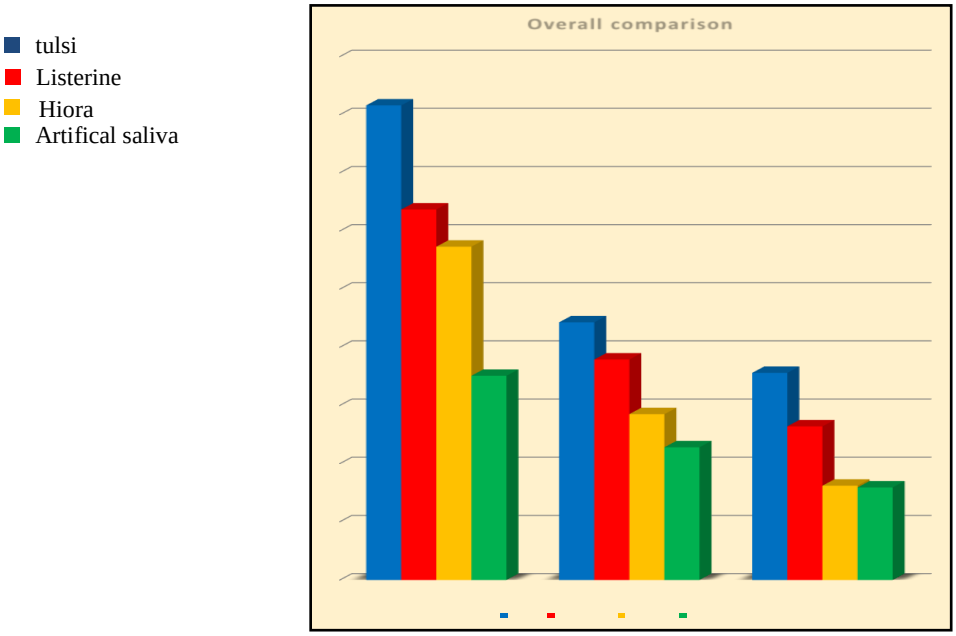
Material	Composition	Manufacture
Listerine	21.6% Alcohol, 0.064% Thymol, 0.092% Eucalyptol, 0.06% Methyl salicylate, 0.042% Menthol, Water, Sorbitol, Sodium saccharin, Sodium benzoate, Benzoic acid	Johnson&Johnson Inc., USA
Hiora	Each gram contains : Bibhitaki (Terminalia bellirica) 10 mg, Nagavalli (Piper betle) 10 mg, Pilu (Salvadora persica) 5 mg Powders : Peppermint Satva (Mentha piperita) 1.6 mg, Yavani satva (Trachyspermum ammi) 0.4 mg Oils : Gandhapura Taila (Gaultheria fragrantissima) 1.2 mg, Ela (Elettaria cardamomum) Other ingredients Sodium Benzoate IP, Bronopol IP, Potassium Sorbate, Saccharin Sodium IP 0.2%	The himalayan drug company
Tulsi extract	The powder was macerated with 100% ethan followed by filtration.	

Table 2 mouth rinses and their composition

RESULTS

Solutions	**Materials**			**Pvalue**
	Giomer	**RMGIC**	**GIC**	
Tulsi	8.16±3.48	4.43±2.03	3.56±1.82	<0.001*
Listerine	6.37±2.55	3.79±1.95	2.64±1.57	<0.001*
Hiora-K	5.73±2.18	2.85±1.68	1.62±0.96	<0.001*
Artificialsaliva	3.51±2.07	2.28±1.44	1.59±0.89	0.216
Pvalue	<0.001*	<0.001*	<0.001*	

Table 3 showing highest ΔE with tulsi based mouthrinse followed by listerine, hiora and least in artificial saliva(control group). Giomer showed highest colour change in tulsi based mouthrinse and GIC showed least change in hiora and artificial saliva which was not significant.



Graph 1 shows the overall comparison of ΔE of each material after immersion in tulsi, hiora and listerine mouthwashes and control group respectively.

DISCUSSION

Daily use of mouthrinses have proven to increasethe staining of aesthetic restorative materials.There are a number of intrinsic and extrinsic factors that can impact the colour stability of resin composite restorations. Use of mouthwashes is regarded as one of the extrinsic factor that endangers the colour stability of aesthetic restorations.Mouthwashes may contain alcohol, detergent, emulsifier,and organic acids, which can cause decomposition and softening of the surface of restorative materials.[1]

Among all the mouthwashes, chlorhexidine is considered to be the "gold standard" antiplaque mouthwash due to its prolonged broad-spectrum antimicrobial and plaque inhibitory potential. It is active against a wide range of Gram-positive and Gram-negative organisms, fungi, facultative anaerobes, and aerobes. Gram-positive cocci especially Streptococcus mutans seems to be sensitive to chlorhexidine which acts by binding to the bacterial cell wall and affects its function.[7,8,9,10] The staining of teeth and oral mucous membranes is a well-known side effect of chlorhexidine mouth rinses. Low-pH mouthwashes with a greater alcohol concentration, such as Listerine (which has a pH of 4.2), may influence the physical-mechanical properties, weakening the aesthetic restorative materials and dramatically speeding up their biodegradation over time. This phenomenon is a complicated process that could lead to the collapse of the composite polymer matrix, which could lead to a number of issues such as the debonding of the filler-polymer matrix, the release of leftover monomers, and wear and erosion that results in staining.[11] High levels of ingredients such as ethanol and phosphoric acid in some mouthwashes can affect the surface properties of the restorative materials (Gurgan et al. 1997).[1]

Hiora [Himalaya Herbals] contains Pilu [Salvadora persica], Nagavalli [Piper betle], Bibhitaki [Terminalia bellerica], Gandhapura taila [Gaultheria fragrantissima], Ela [Elettaria cardamomum], Peppermint satva [Mentha piperita], and Yavani satva [Trachyspermum ammi]. They possess the desired antimicrobial, anti-inflammatory effects, and anticarcinogenic properties.Ramamurthy J compared the efficacy of chlorhexidine and Hiora mouth wash in gingivitis patients for 15 days and found both mouthwashes to be equally effective in treating gingivitis.[12] Jaidka S et al. found that Hiora showed maximum reduction in plaque accumulation, gingival inflammation, and microbial load followed by xylitol and chlorhexidine after 30 days in caries free children.[13] Gupta R et al. stated that Hiora and T. chebula could be used as alternative mouthwashes to chlorhexidine as they reported no side effects in children.[14]

Tulsi is an aromatic shrub in the basil family Lamiaceae (tribe ocimeae). Tulsi tastes hot and bitter and is said to penetrate the deep tissues, dry tissue secretions and normalize kapha and vata. It has a unique combination of actions that include: Antimicrobial (including antibacterial, antiviral, antifungal, antiprotozoal, antimalarial, anthelmintic),anti-oxidant, anti-cataract, anti-inflammatory, chemopreventive, cardio-protective, anti-diabetic, anti-hypercholesterolemia, anti-carcinogenic, immunomodulatory, central nervous system depressant, memory enhancement, anti-asthmatic, anti-spasmodic, anti-arthritic, adaptogenic, anti-stress, anti-leukodermal and anti-coagulant activities. Tulsi's broad-spectrum activity against Streptococcus mutans, can be used as a herbal mouth wash for treating bad breath, gum disease and mouth ulcers. This has been confirmed in clinical trials that rinsing with tulsi is as effective as 0.2% Chlorhexidine and Listerine in reducing the levels of Streptococcus mutans and that a herbal mouthwash that includes tulsi is preferred for its taste and convenience.[3]Agarwal P et al, analyzed the effect of various concentrations of the Ocimum sanctum extract ranging from 0.5 to 10%, and observed that a 4% concentration of the extract was optimum as an antibacterial agent against S. mutans.[15] Subramanian et al. demonstrated that the ethanolic extract of tulsi (Ocimum sanctum), when compared to other extracts, had stronger antibacterial activity.[16] It has been shown that the medicinal properties of tulsi (O. sanctum) are mostly due to eugenol (1hydroxy2 methoxy4allylbenzene), the active ingredient present in tulsi.[17]

The resin matrix, the size of the filler, and the photoinitiator system of the composites are a few examples of intrinsic factors. A significant impact on colour stability results from incomplete polymerization of the resin matrix. Surface smoothness and susceptibility to extrinsic staining are both influenced by the size of the filler particles used in the composite. Poor oral hygiene, poor diet, and smoking habits causes discolouration. Camphoroquinone, a diketone photoinitiator that is visible light-sensitive and in charge of starting free radical polymerization, is typically present in resin composite systems. It absorbs photons causing it to transit from its ground state to an excited triplet state. An amino-alkyl free radical that can start polymerization arises when the excited triplet strikes an amine co-initiator. When photoactivated, the colour of camphoroquinone, which is initially yellow, changes to "transparent." The final colour of the composite resin exhibits a small amount of residual yellow camphoroquinone, which is inactive when the activating irradiation is insufficient and may result in a deeper colour in the restorative material.[18]

The results of the present study showed that RMGIC exhibited higher colour stability as compared to Giomer.Giomers are hybrid materials that are composed of both a composite component and a GI component. It contains pre-reacted glass particles and the glass component's acid-base reaction takes place before insertion within the resin matrix.[4] Beautifil II (Giomer) contains 68% of its content as filler. One of potential cause of degradation-induced discolouration is water sorption. The water sorption in giomer could be due to the presence of prereacted glass polyacid zones which become as a part of the filler structure. These zones on the surface of glass filler particles appear to generate osmotic effect which in turn implies greater the degree of water sorption. (Adusumilli et al 2020). The colour is affected by matrix,filler composition, filler content, initiation components and the interactions of each of thesecomponents (Gurdal et al 2021).[19]Gonulol et al compared the colour stability, water sorption, and solubility of a giomer composite and two nanohybrid composite resins and found that giomer had the highest water sorption and discolouration values which is same as our results.[20]Also Ozdas et al in their study found the highest colour change in giomer compared to other materials when immersed in different liquids.[21]

GIC introduced in 1972 by Wilson and Kent has a property of low coefficient of thermal expansion, physico-chemical bonding to both enamel and dentin, and the release of fluoride but are less acceptable due to poor abrasion and fracture resistance than resin-based materials. In accordance to Tuzuner et al[22] and Kale et al[23], GIC showed the highest colour stability. This could be because of high water content in GIC than RMGIC such that former absorb less water and therefore less susceptible to staining. In contrast, study by Bagheri et al[24] have shown that the water sorption of resin-modified glass-ionomers is higher than that of conventional glass-ionomer cements because of the rapid water sorption by HEMA, a significant resin component, in resin modified glass-ionomer cements.

Also, the immersion duration of the materials into the test solutions affects the colour changes (Khokhar et al., 1991)[25]. According to NBS, the colour change between 0.0 and 0.5 is marked as trace, 0.5–1.5 is slight, 1.5–3.0 is noticeable, 3.0–6.0 is appreciable, 6.0–12.0 is much and >12 is very much (Anil et al., 1999)[26]. When discussing the clinical relevance of these results, the oral environment must be considered, as it differs in several ways from in vitro conditions. Factors such as the variety of food, saliva, and their interactions might intensify discolouration.[2]

There are numerous studies in literature done to evaluate the antibacterial effects of tulsi but very few to check its staining properties. The study can be extended to more precisely determine the effectiveness of tulsi extract as a mouthrinse. The long-term impact of these products on dental health require more research. It is important to evaluate the function of these mouthwashes with a focus on people who have poor oral hygiene. One can certainly propose tulsi extract as a mouthrinse, especially for rural populations who have easy access to tulsi which makes it highly cost-effective,and also as in literature there is no specified adverse effects of tulsi on humans.

CONCLUSION

The results of the present study indicated a significant difference between effect of mouthrinses on colour change of tested restorative materials.Tulsi based mouthrinse caused the highest discolouration and Hiora K caused the lowest. The highest colour change occurred to Giomer and GIC was leastaffected .

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