Effect of KI on SDF Treated Cavities

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Abstract

Background: Dental caries is the most frequent chronic disease worldwide. However, Dental caries can be prevented or arrested. Recently interest in the use of silver diamine fluoride (SDF) has been growing. (SDF) is a solution containing ionic silver, fluoride, and ammonia that arrests the progress of carious lesions and prevents the development of future caries. In Vitro studies demonstrated that SDF increases the pH of biofilm, reduces dentin demineralization, and has antimicrobial action against cariogenic bacteria. But it produces a lesion darker (brown to black) than the original, which is the major criticism of the material. To counter the staining, many studies have tested SDF treatment immediately followed with a saturated solution of potassium iodide.

Material and Methods: A vitro study done in Qassim University, with sample of 30 extracted premolars, divided into 3 groups, (Group A): received silver diamine fluoride, followed by application of Potassium iodide. (Group B): cavity preparation 1 mm in enamel then Received silver diamine fluoride followed by application of Potassium Iodide. And (Group C): cavity preparation 1 mm beyond dentoenamel junction then Received silver diamine fluoride followed by application of Potassium Iodide.

Result: There was a statistically significant differences between three groups on color measurement p= (0.020), this means that the prevalence for group c-based change color teeth compared to group A and B.

Conclusion: SDF + KI treatment showed a low intensity staining in superficial and deep cavities. The intensity of staining decreased significantly in dentin prepared cavities.

Key words: *silver diamine fluoride - Potassium Iodide- Enamel -Dentin – Dark stain.*

Introduction

Dental caries is the most severe chronic condition worldwide. The drill and fill technique of dental caries demand well trained dentists and equipment [(1)].

Some cases of patients that have been severely compromised and underserved leave carious lesions without treatment. However, it is possible to avoid or arrest dental caries [(2)]. Recently concern has been rising in the use of silver diamine fluoride (SDF). In 2015, US Food and Drug Administration approved (SDF) as a treatment for dentinal sensitivity .SDF solution was recently approved as a caries-arresting medicament, this solution is containing ionic silver, fluoride, and ammonia that arrests the progress of caries process and prevents the development of future

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caries [3,4].

Many studies confirmed that SDF increases the pH of biofilm, reduces dentin demineralization, and showed antimicrobial action against cariogenic bacteria. However, it produces a lesion darker (brown to black) than the original, which is the major criticism of the material [5-7].

To counter the staining, many researchers have tested SDF treatment immediately followed with a saturated solution of potassium iodide [8].

It has been approved by studies that Treatments of teeth with KI solution after SDF treatment significantly reduced the discoloration caused by SDF. In this research, we tested SDF application followed by KI effectiveness in different cavity depths.

Material and Methods

Thirty human premolars, extracted for periodontal problem, were collected free of caries, previous restorations or stains.

The premolars teeth surfaces were hand scaled to remove any remaining soft tissue and were stored in a 0.1% thymol solution at 4 °C before use.

Each individual premolar was mounted in (Shiva product dental stone plaster, Maharashtra-India) ensuring visible entire crown.

The premolar teeth were divided into 3, first group (Group A): received silver diamine fluoride, followed by application of Potassium iodide.

The second group (Group B) were prepared for a class I glass ionomer restoration, 1 mm into Enamel, with parallel walls and a stain-free dentinoenamel junction. Silver diamine fluoride followed by application of Potassium iodide were applied to the prepared teeth. The reaction products washed away and dried with oil-free compressed air and filled with glass ionomer restoration.

Third group (Group C): were prepared for a class I glass ionomer restoration, 1 mm into dentin, with parallel walls. Silver diamine fluoride followed by application of Potassium iodide were applied to the prepared teeth. The reaction products washed away and dried with oil-free compressed air and filled with glass ionomer restoration.

Class I cavity preparation in groups B and C prepared using a high speed 330 carbide bur. SDF, Fagamin - 38% Silver Diamine Fluoride- Tedequim) was applied to prepared cavities a small brush followed by application KI liquid, J. CROW'S.

Lugol's sol- distilled water 85% potassium Iodide 5% - J. Crow Company, using separate brush.

The formed white precipitation was washed away with water. Self-cure Glass ionomer restoration (Harvard Ionoglas Fill Extra OptiCaps, shade A2) was applied to the prepared cavities. The cavity was washed with water and dried with cotton pellet. Harvard Iono glass conditioner (20% polyacrylic acid)) applied using cotton pellet for 20 seconds to remove the smear layer. Cavity rinsed with the water and dried Gently. Mixing the omegalas capsule for 10 seconds and a cavity filling within 15 seconds after end of mix. Then Harvard Ionocoat LC applied and light cure (using halogen curing light (3 M ESPE, St Paul, USA) with a light output of 600 mW / cm2) for 20 seconds. All specimens were preserved in artificial saliva.

Specimens were photographed, using, Camera (iPhone max 12 MP, f/1.8, 26mm ½.55", 1.4µm, dual pixel PDAF, OIS) immediately after treatment and every week for four weeks.

The color of each tooth was measured using Nix Pro color sensor (Canada).

The color sensor provides its own calibrated light source using industry standard 45/0° measurement and color readouts in CIELAB (is a color space defined by the International Commission on Illumination) and

calculate the color difference in Dellta-E2000.

The color of each tooth was recorded immediately after treatment and one weekly four weeks later, The Nix color sensor was applied to collect color change data. ΔE and ΔL records of each group were measured and compared between each of the groups.

Statistical Analysis

Analysis of the data was carried out using SPSS, version 24 statistical program for descriptive and analytical statistics to detect difference between groups, the significant was considered when the p-value is less than 0.05 ($p < 0.05$).

Two well-known tests of normality were used, the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test.

Results

Thirty specimens were treated with silver diamine fluoride followed by KI.

Figure (1) shows each group example photos of the teeth immediately and after preparation, every week, for one-month post-treatment.

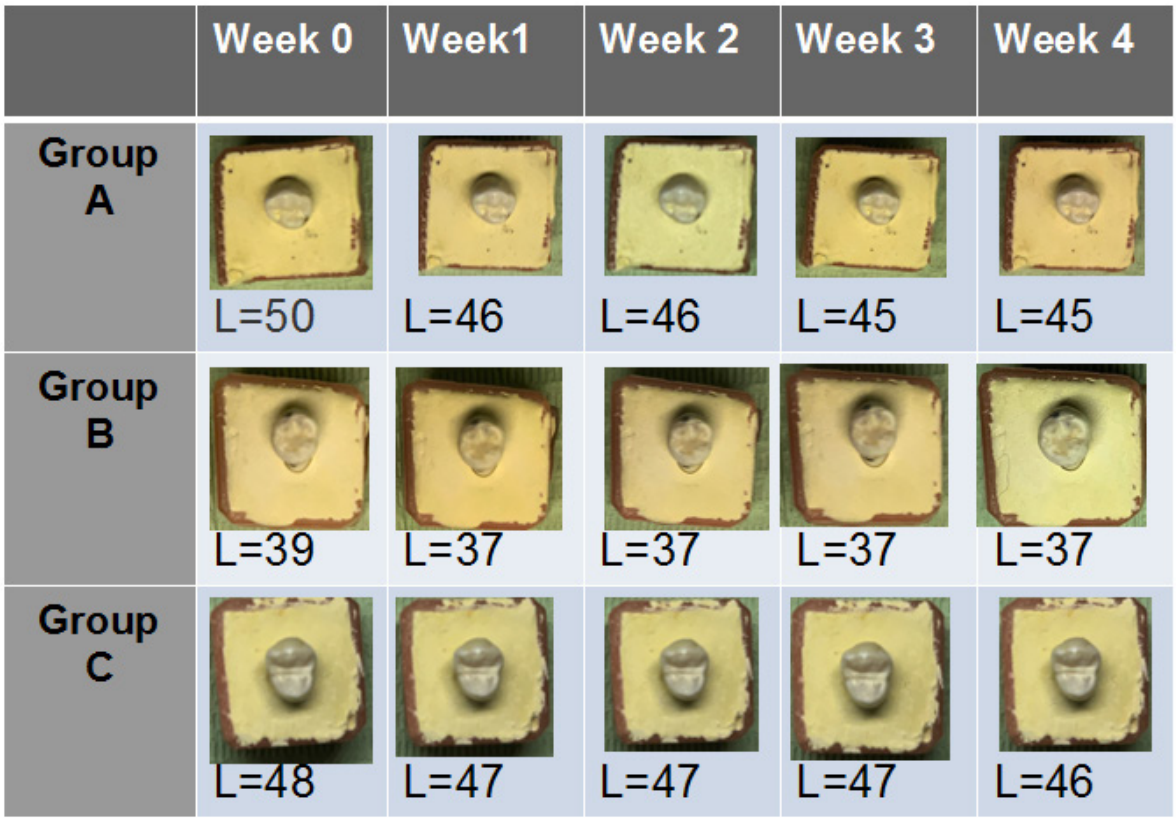

Fig. (1): Each group example photos

After the four weeks, the weekly color measurements for groups A, B and C were compared to determine the effectiveness of Potassium application on teeth color receiving SDF in different cavity depth.

It was found for group A that "No change in color" was the highest 60 %, whilst "Change in color not visible" and "Change in color is visible" were 30% and 10% consecutive on week 1. "Change in color not visible" on Week 2 and week 3 recorded the highest proportion equally 60% and on week4 50% fig (2).

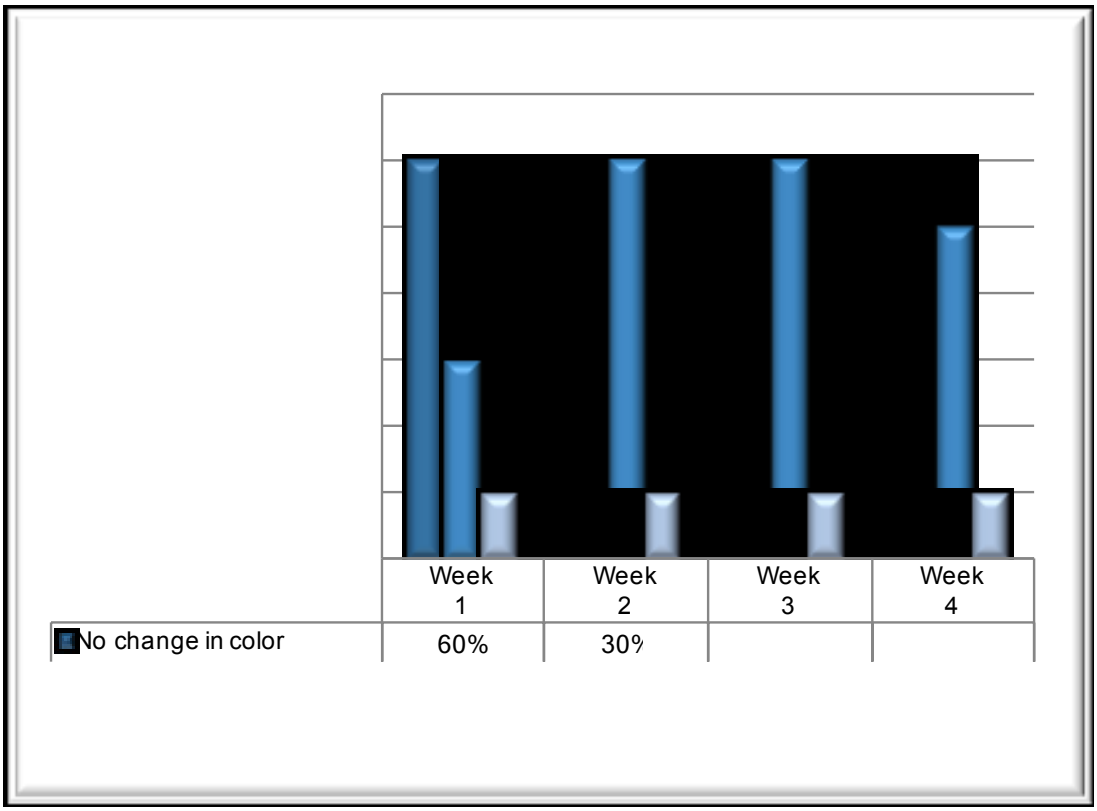

Fig (2): Chart Shows the color change in group A.

In group B it was found that "No change in color" was the highest percentage on week1 and on week 2, 60 % and 50% respectively. "No change in color" on Week 2 and on week 3 recorded the highest proportion 50% and 60% consecutive fig. (3)

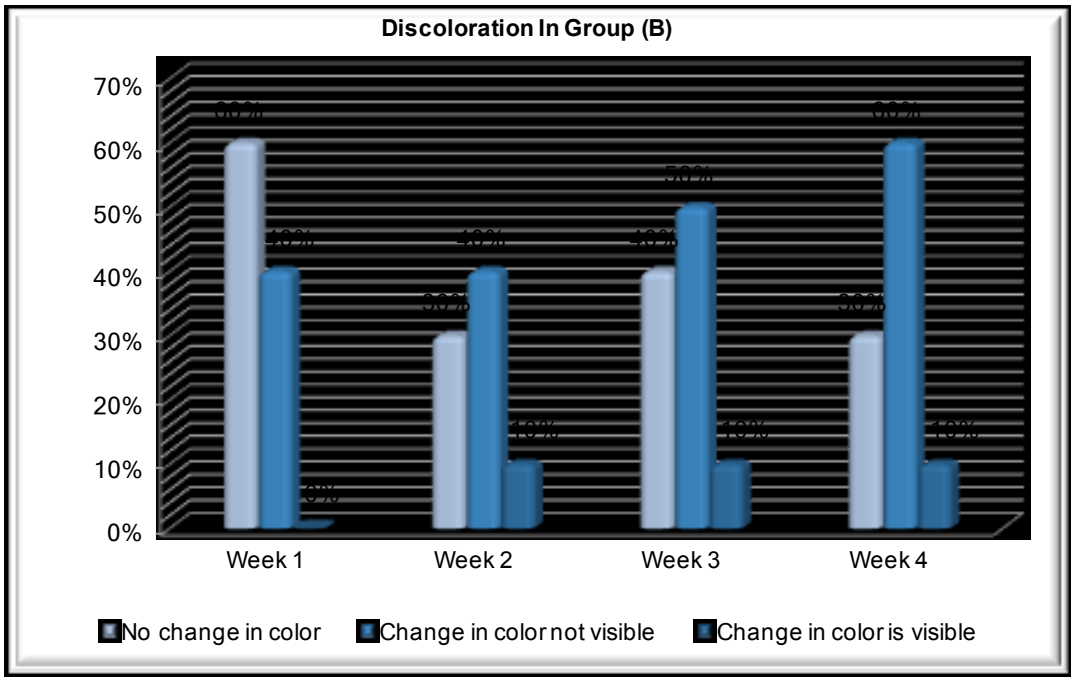

Fig (3): Chart shows the color change in group B.

In group C, it was found that "No change in color" was the highest percentage on all four weeks (week1 90%, while week 2, week3 and week4 equally 70% fig (4).

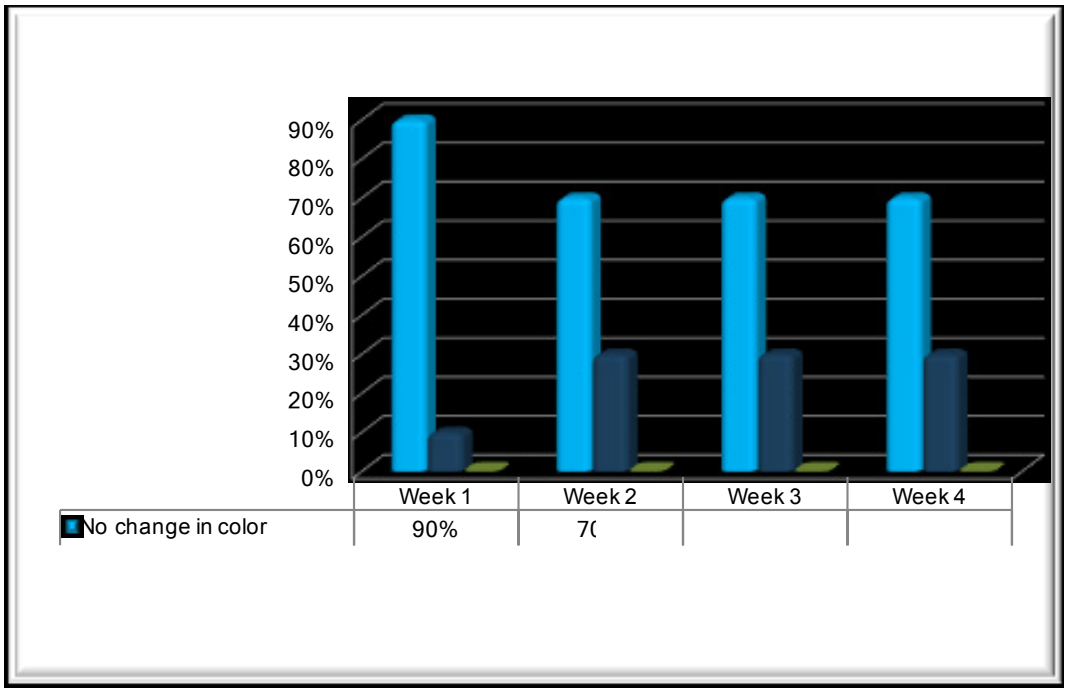

Fig 4: Chart shows the color change in group C.

The Distribution of Color measurements score of the three groups showed that there is no change in color result difference, in group c in four weeks, that had a 1 mm beyond Dentioenaml junction cavity and receive sodium diamine fluoride followed by application of Potassium iodide, so Potassium application on teeth receiving SDF in differences cavity depth is effective table 1.

Table 1: Distribution of Color measurements score on group (A), (B) and (C) among 4 weeks

Week	Color measurements								
	No change in color result difference (1-3)			Change in color not visible (4-6)			Change in color is visible (7-10)		
	A	B	C	A	B	C	A	B	C
Weak1	_	--	10teeth	10teeth -	10teeth	--	--	--	--
Weak2	--	--	10teeth	--	10teeth	--	10teeth	--	--
Weak3	--	--	10teeth	--	--	--	10teeth	10teeth	--
Weak4	--	--	10teeth	--	--	--	10teeth	10teeth	--

Testing for Normality Distribution:

Two well-known tests of normality were used, the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test. The Shapiro-Wilk Test is more appropriate for small sample sizes (< 50 samples.) if the Sig. value of the Shapiro-Wilk Test is greater than 0.05, the data is normal. If it is below 0.05, the data significantly deviate from a normal distribution table 2.

Table 2. Presents the results from two tests of normality, namely the Kolmogorov-Smirnov Test and the Shapiro-Wilk Test.

	Kolmogorov-Smirnov b			Shapiro-Wilk		
	Statistic	**Df**	**Sig**	**Statistic**	**Df**	**Sig**
Week1	.360	10	.001	.731	10	.002
Week2	.324	10	.004	.794	10	.012
Week3	.324	10	.004	.794	10	.012
Week4	.272	10	.036	.802	10	.015
a.	VAR00003 is constant. it has been omitted					
b.	Lilliefors Significance Correction					

Test differences between teeth groups:

discoloration of teeth on the tested three groups evaluated using the Chi-square test (α =0.05), that was indicated for qualitative data, for a non-matching comparison between two groups.

Table 3. shows that there are statistically significant differences between three groups on color measurement p= (0.020), this means that the prevalence for group c-based change color teeth compared to group A and C.

Test Statistics[a,b]	
	VAR00013
Chi-Square	7.873
Df	2
Asymp. Sig.	.020*
a. Kruskal Wallis Test	
b. Grouping Variable: VAR00012	

Discussion

(SDF) is a solution containing ionic silver, fluoride, and ammonia which

arrests the progression of carious lesions and prevents potential caries from developing [9,10].

The free fluoride ions are required for enamel and dentin remineralization; however, the silver precipitate is the main cause of the black stain of the treated dental tissues [11].

A positive approach to solving this problem is the immediate application of the KI solution after SDF treatment. As KI reacts with free silver ions, forming a creamy yellowish silver iodide precipitate that can be washed away and eliminates the black staining caused by SDF application [8].

The effectiveness of SDF in arresting caries was not affected, or minimally affected by the application of KI potassium. Many studies found that SDF dental tissues staining potential is modified by application of KI and that KI had little to no darkening ([12,13].

Our color analysis results showed that tested cavities prepared in dentin had lesser SDF darkening effect than tested cavities papered on enamel surface.

The teeth having no or in enamel cavities had more potential for discoloration on the margin of cavity or the surface.

These findings may be explained as

The KI solution is suggested to be able to react with SDF to form a bright yellow solid compound (silver iodide) [14] and this reaction may minimize the excess free silver ions that result in black staining [15].

While the bright yellow precipitates may be seen after KI application and washed away, slight darkening of tooth external tooth surfaces in this study could still be observed with the SDF + KI treatment to teeth surface or in enamel prepared cavities surfaces.

Also, this darkening increased and could be eye visible week by week.

Silver iodide is considered highly photosensitive and, by exposure to light, can dissociate into metallic silver and iodine, Hence, darkening still occurred on enamel margins.

Li et al reported immediate application of KI after SDF had nonsignificant effect on reducing the characteristic black stain of SDF [16]. SDF= KI treated enamel lesions turned yellow immediately after application of KI, but after 30 months the color of arrested lesions was stained similarly in case of the treatment with SDF or SDF-KI.

Application of a KI can delay the staining process but eventually the arrested enamel lesion becomes dark.

Conclusion

SDF + KI treatment showed a low intensity staining in superficial and deep cavities. The intensity of staining decreased significantly with the increase of prepared cavity depth with the highest staining intensity on surface enamel treatment.

We recommend SDF + KI treatment especially in cavities with caries recurrence.

List of Abbreviations

SDF: Silver diamine fluoride

KI: Potassium Iodide

Conflict of Interests: None

Ethics. Qassim university scientific research ethics committee approval with the reference number: F2018-3004.

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