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RADIOGRAPHIC ASSESSMENT OF SILVER MODIFIED ATRAUMATIC RESTORATIVE TECHNIQUE IN COMPARISON TO ATRAUMATIC RESTORATIVE TECHNIQUE

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ABSTRACT

Background: Silver diamine fluoride (SDF) has promising feedback in remineralization and arresting carious lesions.

Aim: to assess the radiographic outcome of silver modified atraumatic restorative technique (SMART) in comparison to atraumatic restorative technique (ART).

Methods: a randomized controlled trial with split mouth technique including 42 molars, 21 for experimental (SMART) group and 21 for control (ART) group. Molars of experimental group were treated with SDF and then restored with resin modified glass ionomer cement (RMGIC) while molars of control group were restored with RMGIC after manual removal of caries. All teeth were radiographed immediate postoperatively (at baseline) and after 3 months to assess dentine density below the restoration. Data were collected and statistically analyzed.

Results: There was an increase in radio-density in the experimental group in comparison to the control group that showed statistically significant difference, P-value < 0.001.

Conclusion: Silver diamine fluoride in SMART group induced more remineralization effect than RMGIC in ART group.

KEYWORDS: Pediatric, SDF, Radiographic

INTRODUCTION

Dental caries is an infectious microbiologic disease of the teeth that results in localized dissolution and destruction of the calcified dental tissues. It affects general health, having a negative impact on the quality of life, cognitive development, besides oral health, and growth [(1)].

Management of caries can be obtained by one of two models: the medical model and surgical model. Carious lesions managed by the surgical

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model ways through the conventional 'drill and fill' philosophy which means complete carious tissue removal and the replacement of missing tooth tissue with a restoration [2].

Nowadays, it is better to give dental hard tissues the chance to heal following appropriate interventions, such as remineralisation therapy more than the removal of "diseased structures" of the tooth [3].

Optimising dental health is the main principle of medical model. As, caries should be prevented before it starts, arrested, and eliminated if presents and damage should be reversed as far as possible. The medical model could be achieved through; dietary counselling, establishing proper oral hygiene and anti-caries chemotherapeutic methods to reduce and prevent cariogenic bacteria. [4]

Atraumatic restorative treatment (ART) is a minimally invasive procedure that involves removing markedly softened carious enamel and dentine using only hand instruments without electricity and running water without the need for anaesthesia that is why it is accepted by children. The resulting cavity could be restored with an adhesive material usually the Glass Ionomer Cement (GIC). [5]

GIC can bond chemically to tooth structure through ion exchange mechanism. Also, it releases fluoride and can absorb salivary fluoride from dentifrices, mouthwashes, and topical fluorides. Moreover, it has bacteriostatic and cariostatic effects. [6]

Silver diamine fluoride (SDF) has been used in many countries to treat active caries especially for children who are difficult to be managed. It is a water like liquid that is applied to caries using micro brush. Its aim is to stop progression of caries by arresting and remineralization. [7]

A little painful small white mucosal lesion was the only side effect observed in randomized clinical trials in which silver diamine fluoride was applied to multiple teeth to arrest dental caries for 1,493 children, which disappeared at 48 hours without intervention. SDF only darkens the carious lesions. It can cause a "temporary tattoo" to skin (on the patient or provider) which resolves within 2-14 days. A transient metallic or bitter taste was reported but it is still more favourable than that caused by the fluoride varnish. [8]

Alternative ways were introduced to mask the black discoloration of the teeth surfaces for better aesthetics that is a result of silver precipitate, improve chewing ability and prevent food accumulation and so, maintain adequate oral hygiene. Application of composite or GIC restorations after the application of SDF was recommended. This technique is known as silver modified atraumatic restorative technique (SMART). [9]

The aim of the current study was to assess dentine density value radiographically in carious lesions in the SMART (experimental) group and ART (control) group pre-operative and 3 months later.

SUBJECTS AND METHODS

Ethical considerations

The ethical clearance for this study was obtained from research Ethics Committee of Faculty of Dentistry, Minia University (no:329).

Parents signed a written informed consent laid down by the Ethical Committee, Faculty of Dentistry, Minia University. Children older than seven years were also informed about the nature of the study using age-appropriate language. They were allowed to ask any questions related to the trial and choose either to participate or not.

Sample size calculation

The study was designed as a randomized controlled trial. It was calculated using http://sealedenvelope.com based on 30% difference in

success rates of both groups as reported by Dos Santos *et al*.,[10] α level was 0.05%, β 0.2 and power of 80%. The least required sample size was 18 per group and increased to 21 to make up for possible drop out.

Study Setting

Twenty-one subjects were selected from the outpatient clinic in Paediatric and Community Dentistry Department, Faculty of Dentistry, Minia University. The patient had bilateral mandibular carious molars requiring treatments.

Eligibility criteria

Inclusion criteria

1. Children with an age range from 4-6 years of both sexes
2. Apparently healthy children (free from any systemic diseases /genetic disorders).
3. Patient with at least two carious contralateral or opposing carious molars.
4. Parents and patients accepting the new treatment modality and parents assigned the informed consent.
5. Molars with active caries lesions code 4 or 5 or 6 according to international caries detection and assessment system (ICDAS)
6. Clinically: absence of any pathology or pain except of sensitivity with eating.
7. Radiographically: absence of internal or external root resorption, periapical or interradicular radiolucency.

Exclusion criteria

1. Known sensitivity to silver or other heavy-metal ions.
2. Children who will not comply to recall program.
3. Grossly broken-down Teeth.
4. Pulpally involved teeth.
5. Tooth mobility (more than grade 1 (grade 1:1-2 mm tooth mobility).
6. History of pain for a long period of time that may indicate chronic pulp inflammation.

Randomization and allocation concealment

A split mouth technique was used, one side was assigned for the study group (group 1: SMART) and the other was for the control one (group 2: ART). The examined molars were at least one at each side. Children who were eligible for the trial were randomly and equally assigned using a computer-generated list of random numbers (Random Allocation Software, version 1.0.0) to either SMART or ART group.

The participant was given a serial number indicating his/her allocation by an assistant. A duplicate of this number was put in an opaque envelope and was kept by the assistant who would open it only at the time of intervention so the group to which the molar was allocated was concealed from the investigator.

Clinical and radiographic examination:

Under the same dental setting that included a standard light source, sharp explorer and metallic mirror, children were clinically examined by a single investigator and delivered dental treatment to all patients to ensure standardization.

Digital periapical radiographic examination was done pre-operatively and after three months using photostimulable phosphor plate (Fire CR size 2, UId:7EDEB9CB500104E0) and machine (Sirona, HELIODENT Vario, Germany), then processed according to technical instructions.

A standardized periapical radiograph with paralling technique by using a film holder and the prefabricated bite block was done for each patient to make sure that film was inserted at the same place each time as follow:

1. The image plate was inserted into a disposable plastic cover for infection control
2. The bite block was centred in the plastic aiming ring of the XCP (XCP KIT RINN FPS 3000 DENTSPLY, UNITED KINGDOM) film holder.
3. The XCP film holder with size 2 photostimulable phosphor plate and the bite block were positioned in the patient mouth and the patient closed his\her mouth slowly while the occlusal surface was parallel to the floor.
4. The tube head was centred on the aiming ring.
5. Exposure was done then analysed on the computer monitor and analysed using EZ I viewer.

The operative steps

For the experimental group (SMART group 1)

1. The lips were coated with lip balm (Vaseline) to protect them from being stained by SDF.
2. Isolation was done by application of cotton roll used for moisture control.
3. Gross debris were removed without caries excavation, affected surfaces were dried and then, SDF was applied to carious dentine using micro-brush for one minute according to the American Academy of Paediatric Dentistry (AAPD) guidelines and then the excess was removed with cotton tip applicator [11]
4. After dryness of SDF a resin modified glass ionomer (RMGIC) capsules was applied into the cavity and cured according to manufacturer instructions.

Fig. (1): Pre-operative photographs of both sides

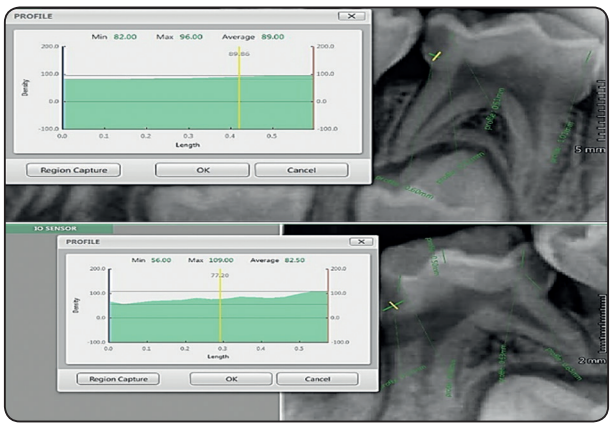

Fig. (2): Pre-operative radiographs of both sides

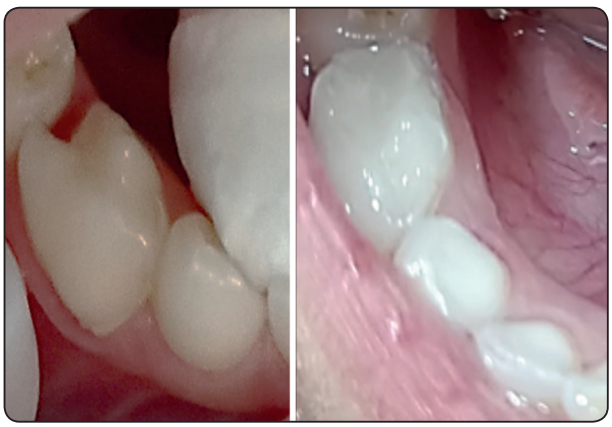

Fig. (3): After removal of caries and application of RMGIC (ART group)

Fig. (4): After application of SDF and then RMGIG (SMART Group)

For the control group:

1. Isolation with cotton rolls.
2. Soft dentine was removed from the periphery of lesion with care to avoid pulp exposure by sharp excavator.
3. RMGIC was applied and cured according to manufacturer instructions.

Post operative instructions

1. The patient was asked not to eat or drink for one hour.
2. Oral hygiene instructions were given to parent\ patient to be followed. Toothbrushes and toothpastes were given to participants.
3. Patient was asked to return 3 months later to assess radiographic outcome.

Statistical analysis

Chi square test and fisher's exact test were used to compare the experimental and control groups. Mann Whitney test was used to compare the change in density among each group.

IBM SPSS 26 for windows software was used for the analysis, and a P-value < 0.05 is considered statistically significant.

Drop out

There was less drop out percentage because of the compliance of the participant and meticulous recall of the parents.

RESULTS

TABLE (1): Assessment of dentine density regarding both groups

Groups	Density value	Minimum	Maximum	Mean	SD
Experimental group	Pre-operative	125.00	144.50	134.00	4.59
	After 3 months	129.00	146.00	136.90	4.27
	Difference	**0.50**	**7.00**	**2.90**	**1.80**
Control group	Pre-operative	125.00	144.00	134.05	4.47
	After 3 months	126.00	144.00	134.76	4.32
	Difference	**0.00**	**2.00**	**0.71**	**0.56**

TABLE (2): Comparison of the change in density for each group

Groups	Difference		P-value
	Median	IQR	
Experimental group	2.5	2.75	**<0.001**
Control group	0.5	0.5	

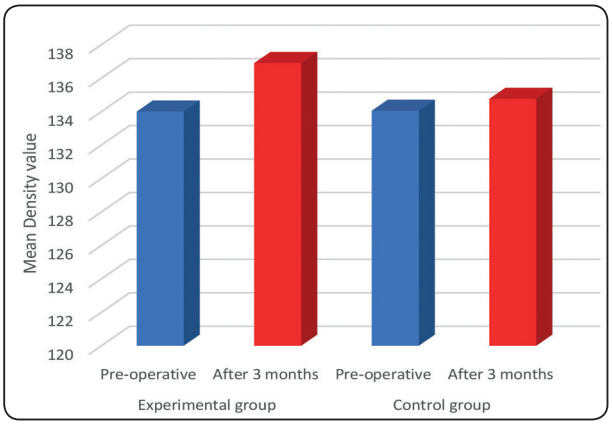

Fig. (5): Bar chart for the change in dentine density in both groups.

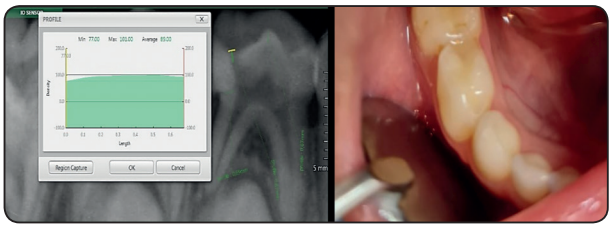

Fig. (6): After 3 months (ART group)

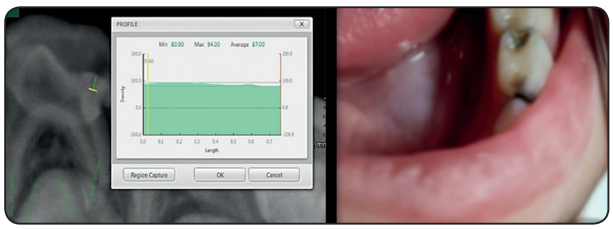

Fig. (7): After 3 months (SMART group)

DISCUSSION

Dental caries is a multifactorial disease that involve alternating processes of demineralization and remineralization of hard tissues. The concept that the demineralized tissues could be remineralized again is increasingly accepted by dental professionals. [12]

Because of the scarce clinical trials and lack of evidence on whether to use SMART or ART in treatment or carious lesions in primary molars. The current study was carried out to evaluate the radiographic success of SMART and ART in treatment of carious lesions.

38% SDF was used (44,800 ppm of fluoride and 253,870 ppm of silver) because it is more effective in inhibiting bacterial growth, enhancing remineralization, and arresting caries as reported systematic reviews. [13]

SDF was applied to carious lesions without caries removal since it was reported that there were no significant differences in the number of arrested tooth surfaces for children who had caries excavation prior to application of SDF compared with those who did not have caries removal. [14].

Radiographic evaluation was conducted using digital radiograph to measure density with sufficient degree of sensitivity using software system by measurement of the change in the remaining carious dentin density. [15]

In this study, there was statistically significant difference in dentine density in SMART group more than was reported with ART group. This may be because of the successful effect of SDF in arresting dentine caries and enhancing remineralization as reported by several studies. [16,17,18,19]

The reported radiographic success of ART in increased dentine density in comparison to preoperative dentine density may be due to the use of RMGIC that has antimicrobial effect, can absorb salivary fluoride from dentifrices, mouthwashes, and topical fluorides, in addition to the release of its chemical components such as fluoride that helps in remineralization of the affected dentine. This was in accordance with many in-vitro studies that showed that, glass hybrid restorations provided coronal remineralization of the residual carious lesions [6,20]

The results of the current study were in accordance with **Zhi. *et al.,*** who reported success rate of SDF in arresting caries while, in a systematic review was carried in 2021 concluded that there was no statistically significant difference between 30% SDF and ART in primary molars at 12 months. [21,22]

The current study results agreed with Dos Santos *et al.* since there was significant difference in caries arrest in primary teeth after SDF treatment more than that was resulted from glass ionomer restoration sealing of carious lesion. [10]

Also, this coincided with Abuhashema *et al.,* who founded that Partial caries removal and using glass hybrid restoration with and without prior application of NSF proved remineralization of the remaining carious dentin, and tertiary dentin formation. [23]

CONCLUSION

Radiographically, SMART technique had more success rate than ART, so it is recommended to be used especially with special health care needs children if the marginal discoloration of SDF under SMART is accepted by parents.

RECOMMENDATIONS

- Future clinical trials are recommended to evaluate the effect of SDF and the survival of SMART over standardized lesions for longer follow up periods.
- Also, several studies are required to evaluate success rate of nanoparticles silver diamine fluoride in remineralization and arresting of caries since it was reported by some studies that nanoparticles type produces less black stains which is the main disadvantage of SDF.

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