



POSTOPERATIVE PAIN AFTER TREATMENT WITH HALL TECHNIQUE VERSUS SILVER DIAMINE FLUORIDE IN THE MANAGEMENT OF CARIOUS PRIMARY MOLARS: A RANDOMIZED CLINICAL TRIAL

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Abstract

Aim: This study aims to assess postoperative pain after treatment with the Hall technique versus silver diamine fluoride with the management of carious primary molars.

Materials and methods: Forty-eight carious primary molars with vital pulp were divided into two equal groups (n = 24). In the intervention group, the teeth were treated with 38% Silver Diamine Fluoride. In the control group, the teeth were treated with the Hall technique.

Results: The risk of 1 day postoperative pain is 16% (ARR= 0.16 CI -0.0037 to 0.358) more in the Hall technique compared to the SDF technique; the same result was found at 2 days and 1 week. The risk of 6 months postoperative pain is 25% (ARR= -0.25 CI -0.449 to 0.06) less in the Hall technique compared to the SDF technique.

Conclusions: The SDF had a lower risk of postoperative pain by 16% than the Hall technique at 1 day, 2 days, and 1 week. The Hall technique had a lower risk of postoperative pain 25%, than SDF at 6 months.

Keywords: Postoperative pain; Hall Technique; Stainless-steel crowns; Silver Diamine Fluoride; Deep Caries.

1677

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Introduction

Preservation of the primary teeth until physiological exfoliation is one of the essential goals in preventive and interceptive dentistry. The deciduous tooth is important in chewing, speech, esthetics, function, and guiding

permanent teeth eruption. Any disturbance in the shedding of primary teeth due to caries, trauma, or ectopic eruption may lead to undesirable movement of deciduous and permanent teeth, causing significant arch space discrepancy [1]. Dental caries is a



widespread oral disease worldwide. It's been known for over 100 years that dental caries is caused by bacteria fermenting foods, producing acids and distracting tooth structure by dissolving tooth minerals. Caries can occur throughout life in deciduous and permanent dentitions, damaging the tooth crown and exposed root surfaces later in life [2]. Early childhood caries (ECC) treatment remains challenging due to a lack of cooperation with conventional dental treatment that needs local analgesia and cavity preparation using rotary instruments [3,4]. Evidence shows that children who have experienced local analgesia are less likely to cooperate during dental visits and experience more stress and discomfort when using rotary instruments [5]. Hence invasive and conventional dental treatments can be a source of anxiety for children, making patients avoid seeking dental care, and lack of child cooperation can complicate dental treatment. Therefore, alternative noninvasive treatments should be readily applied [6]. Minimal Invasive Dentistry (MID) is a modern conservative approach that reaches the dental treatment objective by decreasing discomfort, pain, stress, restorative procedure time, and lowering patient anxiety. In addition, it significantly enhances children's quality of life [7]. Dr Norna Hall, a general dental practitioner from Scotland, developed and used a noninvasive technique of stainless-steel crown in children that does not require local anaesthesia, caries removal or any painful procedure.

Hall technique is based on scientific evidence that the progression of caries gets arrested once an effective marginal seal is achieved [8]. Silver Diamine Fluoride has been a noninvasive dental treatment since the 1970s in Asia, including China and Japan. SDF has widely been shown effective in preventing dental caries and helping stop caries development after a cavity has formed. On February 20, 2017, 38% SDF was approved in Canada to treat caries in pediatric to adult patients. Furthermore, in 2020, with the global pandemic COVID-19, the SDF emerged as a minimally invasive measure with non-aerosol generating procedures (non-AGPs) for carious

lesions treatment [9]. Therefore, this study aims to assess postoperative pain after treatment with the Hall technique versus silver diamine fluoride with the management of carious primary molars. The null hypothesis suggests no difference between the Hall technique and 38% Silver diamine fluoride in postoperative pain with the management of carious primary molars.

Materials and Methods

1. Study Design and Study Setting

This trial is designed as a randomized clinical trial, with parallel technique and allocation 1:1 ratio. Children participating in this study were recruited from the outpatient clinic of Pediatric Dentistry and Public Health, Faculty of Dentistry, Cairo University. The procedures were performed in the dental unit in the postgraduate clinic of Pediatric Dentistry and Public Health, Faculty of Dentistry, Cairo University. Dental chair: Knight® by Midmark, Corporation, Patterson Blvd., Ohio, USA.

2. Ethical Consideration and Informed Consent

The ethics committee, Faculty of Dentistry, Cairo University, reviewed and approved this research concerning scientific content and regulations. Verbal consent was obtained orally from each child participating in the study. Written informed consent was signed and collected from the parent. Participants were included in the clinical trial if they fulfilled the inclusion criteria. A full description of the study methods and the potential adverse effects were explained to the parent in simple, clear and understandable language. The study protocol was registered in ClinicalTrials.gov (NCT04794426) and written according to CONSORT guidelines for randomized controlled trials.

3. Eligibility criteria

Inclusion criteria are healthy cooperative children aged 4 - 6 years with caries in primary molars within enamel/dentin with vital pulp. Exclusion criteria are the Presence of signs and symptoms of necrosis, Root caries or a history of Spontaneous pain.

4. Sample Size

A power analysis was designed to have adequate power to apply a two-sided statistical

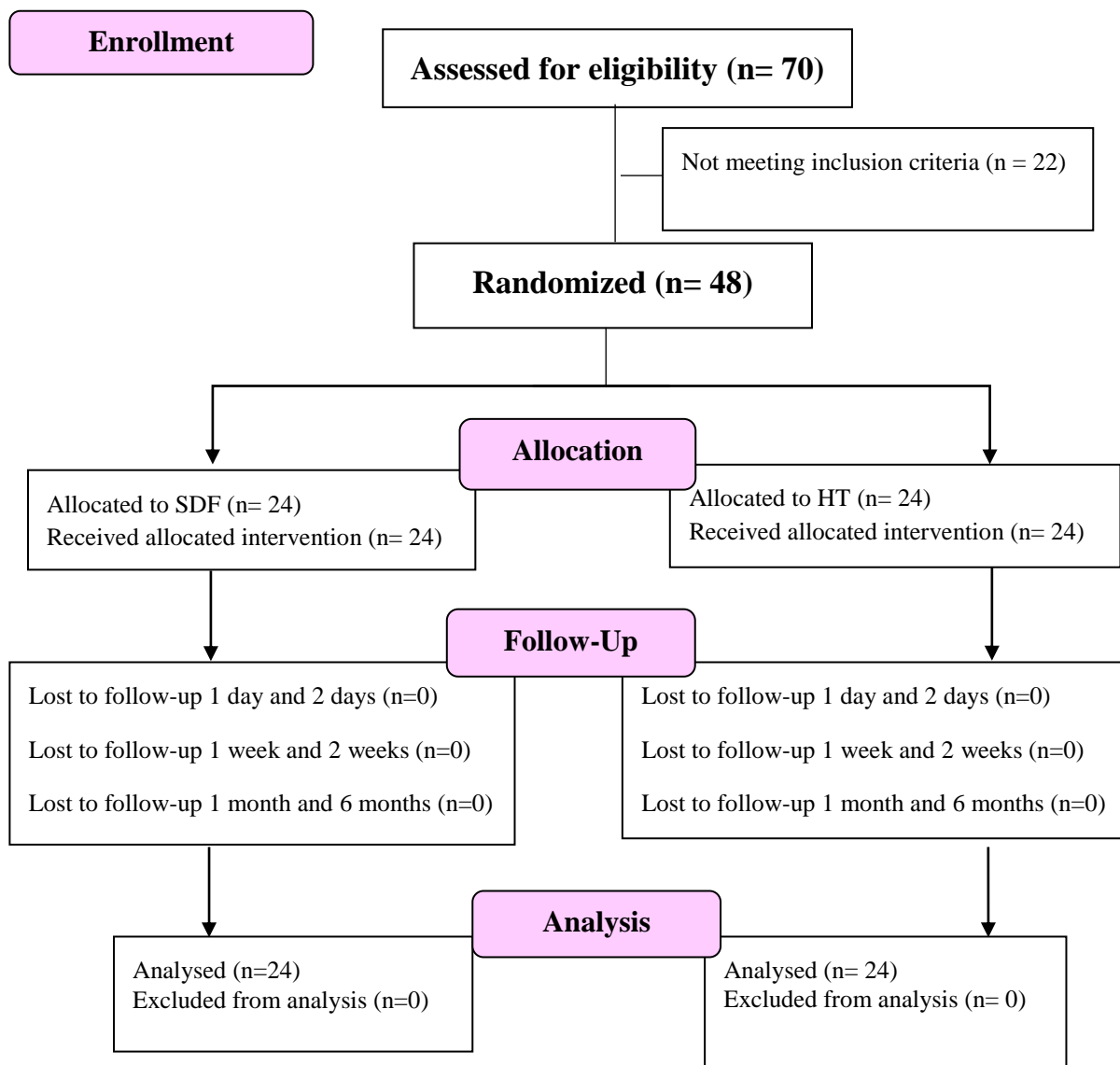
test of the null hypothesis that there is no difference between postoperative pain in the management of carious primary molars with the Hall technique versus the silver diamine fluoride. According to the results of Masoumeh Ebrahimi et al., 2020, the probability of success in the control group was 92% and, according to the expert opinion, estimated the probability of success in the intervention to be 54%. By adopting an alpha (α) level of 0.05 (5%), and beta (β) level of 0.20 (20%), i.e. power=80%, the predicted sample size (n) was found to be (40) cases, i.e. (20) for each group. The sample size was increased by (20%) to account for possible dropouts, to be a total of (48) cases (24) for each group. Sample size calculation

was performed using PS software version 3.0 for Windows 1.

5. Randomization and Allocation

The randomization was generated electronically using (<http://www.random.org/>). The total sample was divided into two equal groups as follows; intervention group: Carious primary molars were randomly selected to be treated with 38% Silver Diamine Fluoride (n=24). Control group: Carious primary molars were randomly selected to be treated with the Hall technique (n=24). Allocation concealment is a 1:1 ratio done using an opaque envelope. The CONSORT flow diagram **Figure (1)** shows the participants' progress through the trial phases.

Figure (1) Consort 2010 flow diagram, showing patient flow during the trial.



1680

6. Blinding

Blinding operators, children, parents and the outcome assessor was not possible due to the nature of the study, as both treatments use different techniques and distinct materials., but statisticians can be blinded.

7. Protocols for Interventions

7.1 Preoperative Phase for Both Groups

The operator filled out a diagnostic chart and performed a diagnosis for the cases. Dental spoon excavators are used to remove obvious gross food debris and

loose plaque from the tooth without removing caries from the cavity. Oral hygiene instruction is given. The digital oral photographs of all patients were taken with a Canon EOS 700D digital camera (Canon, Tokyo, Japan) with a ring flash. Standardized periapical radiographs were taken for all patients to ensure that the proper case included the inclusion criteria

7.2 Intervention Groups: 38% Silver Diamine Fluoride (SDF)

Tooth surfaces were cleaned with gauze and isolated using cotton rolls. The lips and surrounding gingival tissues were protected using petroleum jelly to prevent irritation or staining before applying 38% SDF (Riva Star, SDI Limited, Victoria, Australia). A micro sponge brush was used for application. A gentle flow of compressed air was then used to dry the tooth for at least one minute. Riva Star KI was applied after the SDF application until the white reactant became clear. The tooth was isolated for

up to three minutes, and postoperative instruction was given. Parents were informed that children should not eat or drink for one hour after treatment. The second application was made after 6 months [10]. The steps of the SDF application are shown in Figures (2 a-e).



1681

7.3 Control Groups: Hall Technique (HT)

After evaluating tooth shape and occlusion in the HT group, the SSC (3M ESPE, St. Paul, Minn., USA) was checked without fully seating it. Tooth surfaces were cleaned, and then the SSC was loaded with glass ionomer luting cement (Riva Self Cure Capsules, SDI Limited, Victoria, Australia) and positioned partially on the tooth using a finger. The patient bit on a cotton roll, and the SSC was fully seated. Excess cement was removed, and postoperative instruction was given [11]. The steps of the HT are shown in Figures (3 a-g).

8. Outcome Assessment:

8.1 Postoperative pain

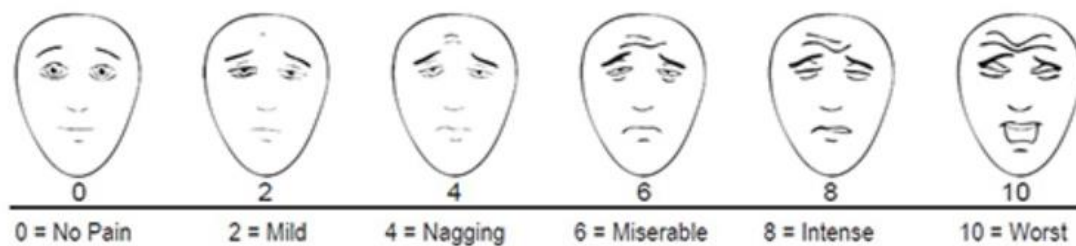


Figure (4) Face Pain Scale-Revised (FPSR) (Hicks et al., 2001).

9. Statistical methods

Numerical data were explored for normality by checking the distribution of data and using tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk tests). Age data showed normal (parametric) distribution, while pain scores were non-parametric. Numerical data were presented as mean, standard deviation (SD), median, range, Inter-Quartile Range (IQR) and 95% Confidence Interval (95% CI) for the mean values. Student's t-test was used for parametric data to compare mean age values in the two groups. For non-parametric data, the Mann-Whitney U test was used to compare between pain scores in the two groups. Friedman's test was used to study the changes by time within each group. Dunn's test was used for pair-wise comparisons when Friedman's test was significant. Kaplan-Meier survival curve was constructed to calculate the

For both groups, follow-up was obtained after 1 day, 2 days, 1 week, 2 weeks, 1 month, and 6 months to assess postoperative pain. Face Pain Scale-Revised (FPSR) Figure (4), an ordinal six-point scale ranging from 0 to 10. The degree of pain was defined in this way: (0 = no pain), (2 = mild pain), (4 = nagging), (6 = miserable), (8 = intense), and (10 = worst). The Form of Face Pain Scale Revised was delivered to the parents. Children were asked to select the face representing the pain's severity. The form was returned to the researcher after 6 months.

estimated mean time to pain occurring in the two groups. Comparison between times was performed using the Log-rank test. Qualitative data were presented as frequencies and percentages. The chi-square test and Fisher's Exact test were used to compare the two groups regarding qualitative data. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

Results

1. Demographic data

1.1 Patients' demographics

A total of 16 children (11 boys and 5 girls) completed the study. The children were aged between 4 to 6 years. The statistics of the demographic data showed that the age of the SDF group participants was (mean age 4.5

years; SD ± 0.55 years) younger than the HT group (mean age 5 years; SD ± 0.47 years), and the sex distribution in the SDF group were (66.7%) boys and (33.3%) girls while HT group were (70%) boys and (30%) girls.

Subsequently, there was no statistically significant difference between gender distributions in the two groups ($P= 1$). There was also no statistically significant difference between mean age values in the two groups ($P= 0.073$).

Table (1): Descriptive statistics and results of Fisher's Exact test and Student's t-test for comparisons between demographic data of the two groups

| DEMOGRAPHIC DATA | SDF (N = 6 PATIENTS) | HALL TECHNIQUE (N = 10) | P-VALUE |
|------------------|----------------------|-------------------------|---------|
| Gender [n, (%)] | | | |
| Boy | 4 (66.7%) | 7 (70%) | 1 |
| Girl | 2 (33.3%) | 3 (30%) | |
| Age [Mean, SD] | 4.5 (0.55) | 5 (0.47) | 0.073 |

*: Significant at $P \leq 0.05$

1.2 Teeth data

There was no statistically significant difference between teeth types in the two groups ($P= 0.376$). There was also no statistically significant difference between arch distributions in the two groups ($P= 0.564$).

1683

Table (2) Frequencies (n), percentages (%), and results of Chi-square test for comparisons between teeth data of the two groups

| Teeth data | SDF (n = 24 teeth) | | Hall technique (n = 24 teeth) | | P-value |
|------------------------|--------------------|------|-------------------------------|------|---------|
| | n | % | N | % | |
| Tooth type | | | | | |
| First deciduous molar | 11 | 45.8 | 8 | 33.3 | 0.376 |
| Second deciduous molar | 13 | 54.2 | 16 | 66.7 | |
| Arch | | | | | |
| Lower | 11 | 45.8 | 13 | 54.2 | 0.564 |
| Upper | 13 | 54.2 | 11 | 45.8 | |

*: Significant at $P \leq 0.05$

2. Postoperative pain (Face pain scale) scores

2.1 Descriptive statistics

Median, range, Inter-Quartile range (IQR), mean, standard deviation (SD) and 95% Confidence Interval for the mean values of pain scores in the two groups are presented in Table (3).

Table (3) Descriptive statistics for pain scores in the two groups

| Group | Time | Median | Range | IQR | Mean | SD | 95% CI for the mean |
|-------|-------|--------|-------|-----|------|----|---------------------|
| SDF | 1 day | 0 | 0-0 | 0-0 | 0 | - | - |

| | | | | | | | |
|--|-----------------|----------|------------|--------------|-------------|-------------|------------------|
| (n = 24 teeth) | 2 days | 0 | 0-0 | 0-0 | 0 | - | - |
| | 1 week | 0 | 0-0 | 0-0 | 0 | - | - |
| | 2 weeks | 0 | 0-0 | 0-0 | 0 | - | - |
| | 1 month | 0 | 0-0 | 0-0 | 0 | - | - |
| | 6 months | 0 | 0-2 | 0-1.5 | 0.5 | 0.88 | 0.13-0.87 |
| Hall technique (n = 24 teeth) | 1 day | 0 | 0-4 | 0-2 | 1.25 | 1.65 | 0.55-1.95 |
| | 2 days | 0 | 0-4 | 0-1.5 | 0.92 | 1.67 | 0.21-1.62 |
| | 1 week | 0 | 0-2 | 0-0 | 0.42 | 0.83 | 0.07-0.77 |
| | 2 weeks | 0 | 0-0 | 0-0 | 0 | - | - |
| | 1 month | 0 | 0-0 | 0-0 | 0 | - | - |
| | 6 months | 0 | 0-0 | 0-0 | 0 | - | - |

1684

2.2 Comparison between the two groups

The statistical analysis of postoperative pain after one day showed the median FPSR was 0 range (0-0) in the SDF group compared to the 0 range (0-4) in the HT group. SDF group showed statistically significantly lower pain scores than HT. The Mean of FPSR was 0 for the SDF group and 1.25 (SD \pm 1.65) for the HT group. The mean difference between pain scores in the two groups was (-1.25 with a 95% CI: -1.93- -0.57), indicating that the Hall technique showed higher pain scores than SDF with a value of 1.25.

Postoperative pain after two days showed the median FPSR was 0 range (0-0) in the SDF group compared to 0 range (0-4) in the HT group. SDF showed statistically significantly lower pain scores than the Hall technique. The Mean of FPSR was 0 for the SDF group and 0.92 (SD \pm 1.67) for the HT group. The mean difference between pain scores in the two groups was (-0.92 with a 95% CI: -1.6- -0.23), indicating that the Hall technique showed higher pain scores than SDF with a value of 0.92.

Postoperative pain after one week showed the median FPSR was 0 range (0-0) in the SDF group compared to 0 range (0-2) in the HT group. SDF showed statistically significantly lower pain scores than the Hall technique. The Mean of FPSR was 0 for the SDF group and 0.42 (SD \pm 0.83) for the HT group. The mean difference between pain scores in the two groups was (-0.42 with a 95% CI: -0.76- -0.08), indicating that the Hall technique showed higher pain scores than SDF with a value of 0.42.

After two weeks and one month, none of the cases in the two groups had pain. After six months median FPSR was 0 range (0-2) in the SDF group compared to the 0 range (0-0) in the HT group. SDF showed statistically significantly higher pain scores than the Hall technique. The Mean of FPSR was 0.5 (SD \pm 0.88) for the SDF group and 0 for the HT group. The mean difference between pain scores in the two groups was (0.5 with a 95% CI: 0.14- 0.86), indicating that the Hall technique showed lower pain scores than SDF with a value of 0.5.

Table (4) Descriptive statistics and results of Mann-Whitney U test for comparison between pain scores in the two groups

| Time | SDF (n = 24 teeth) | | HT (n = 24 teeth) | | P- valu e | M ea n dif fer en ce | 95% CI for the mean difference | ARR (CI) | Effe ct size (d) |
|----------|---------------------------|---------------|---------------------------|----------------|-----------------|--|--------------------------------------|----------------------------------|---------------------------|
| | Media n (Range) | Mean (SD) | Media n (Range) | Mean (SD) | | | | | |
| 1 day | 0 (0-0) | 0 (-) | 0(0-4) | 1.25 (1.65) | <0.001 * | -1.25 | -1.93- -0.57 | 0.16 (-0.0037 to 0.358) | 0.76 5 |
| 2 days | 0 (0-0) | 0 (-) | 0(0-4) | 0.92 (1.67) | 0.010* | -0.92 | -1.6- -0.23 | 0.16 (-0.0037 to 0.358) | 0.43 9 |
| 1 week | 0 (0-0) | 0 (-) | 0(0-2) | 0.42 (0.83) | 0.019* | -0.42 | -0.76- -0.08 | 0.16 (-0.0037 to 0.358) | 0.36 3 |
| 2 weeks | 0 (0-0) | 0 (-) | 0(0-0) | 0 (-) | 1 | - | - | - | 0 |
| 1 month | 0 (0-0) | 0 (-) | 0(0-0) | 0 (-) | 1 | - | - | - | 0 |
| 6 months | 0(0-2) | 0.5 (0.88) | 0(0-0) | 0 (-) | 0.010* | 0.5 | 0.14-0.86 | -0.25 (-0.449 to 0.06) | 0.43 9 |

*: Significant at $P \leq 0.05$ ARR = Absolute Risk Reduction

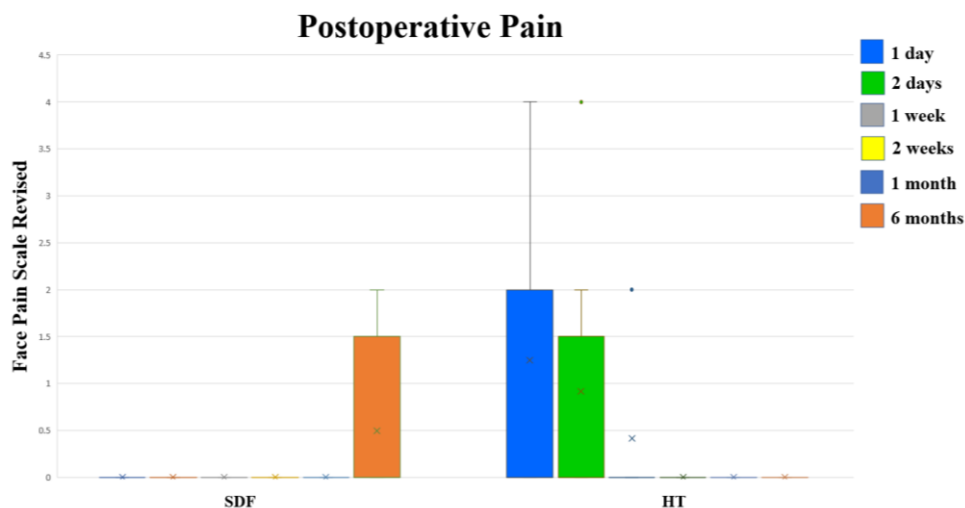


Figure (5): Box plot representing median and range values for pain scores in the two groups (Circle and star represent outliers)

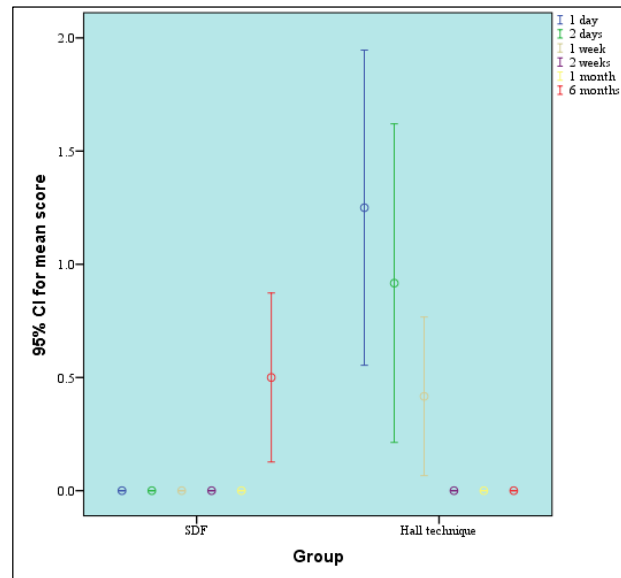


Figure (6) 95% Confidence Interval plot for mean pain scores in the two groups.

Table (5) Frequency and percentage of postoperative pain in the two groups

| | SDF | | | | Hall | | | |
|-----------------|-----|------|--------------|-----|------|------|--------------|-------|
| | N | FPSR | Type Of pain | % | N | FPSR | Type Of pain | % |
| 1 Day | 0 | 0 | No pain | 0 | 4 | 4 | Nagging pain | 16.6% |
| 2 Days | 0 | 0 | No pain | 0 | 4 | 4 | Nagging pain | 16.6% |
| 1 Week | 0 | 0 | No pain | 0 | 4 | 2 | Mild pain | 16.6% |
| 2 Weeks | 0 | 0 | No pain | 0 | 0 | 0 | No pain | 0 |
| 1 Month | 0 | 0 | No pain | 0 | 0 | 0 | No pain | 0 |
| 6 Months | 6 | 2 | Mild pain | 25% | 0 | 0 | No pain | 0 |

1686

N= Count %= Percent FPSR= Face Pain Scale Revised

2.3 Changes within each group

Regarding the SDF group, there was a statistically significant change in pain scores over time. Pair-wise comparisons between periods revealed no statistically significant

change in pain scores after two days, from two days to one week, one week to two weeks, and two weeks to one month. In addition, pain scores were statistically significantly increased from one to six months.



While for the Hall technique group, there was a statistically significant change in pain scores over time. Pair-wise comparisons between periods revealed no statistically significant change in pain scores after two days, followed by a statistically significant decrease in pain

scores from two days to one week and one week to two weeks. There was no statistically significant change in pain scores from two weeks to one month and one to six months.

Table (6) Descriptive statistics and results of Friedman's test for comparison between pain scores at different times within each group

| Time | SDF (n = 24 teeth) | | Hall technique (n = 24 teeth) | |
|------------------------|----------------------|------------|-------------------------------|-------------|
| | Median (Range) | Mean (SD) | Median (Range) | Mean (SD) |
| 1 day | 0 (0-0) ^B | 0 (-) | 0 (0-4) ^A | 1.25 (1.65) |
| 2 days | 0 (0-0) ^B | 0 (-) | 0 (0-4) ^A | 0.92 (1.67) |
| 1 week | 0 (0-0) ^B | 0 (-) | 0 (0-2) ^B | 0.42 (0.83) |
| 2 weeks | 0 (0-0) ^B | 0 (-) | 0 (0-0) ^C | 0 (-) |
| 1 month | 0 (0-0) ^B | 0 (-) | 0 (0-0) ^C | 0 (-) |
| 6 months | 0 (0-2) ^A | 0.5 (0.88) | 0 (0-0) ^C | 0 (-) |
| P-value | <0.001* | | <0.001* | |
| Effect size (w) | 0.250 | | 0.326 | |

*: Significant at $P \leq 0.05$, Different superscripts in the same column indicate statistically significant change over time.

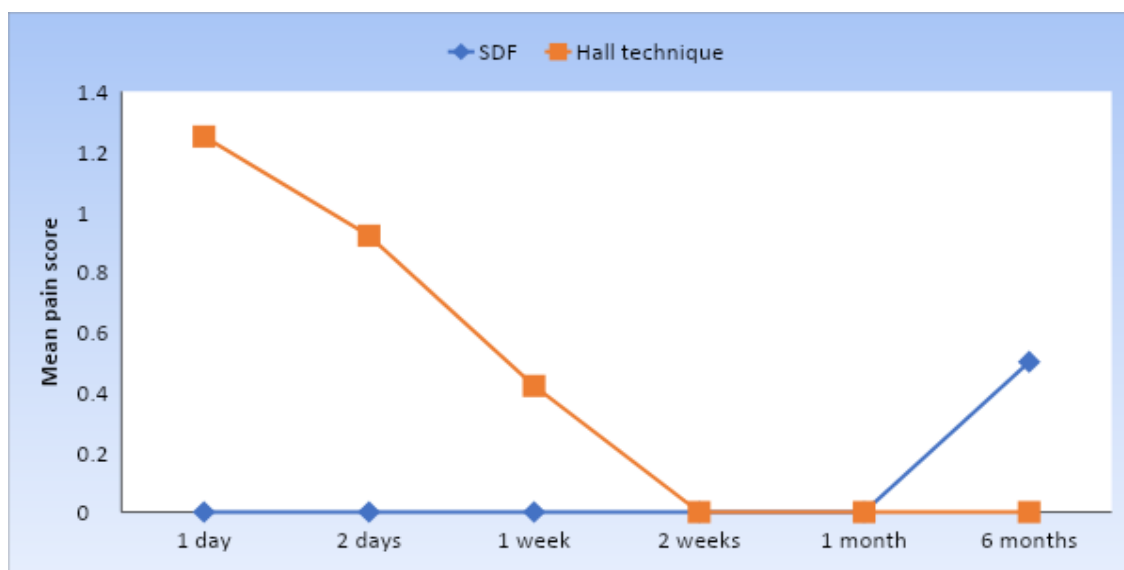


Figure (7) Line chart representing changes in mean pain scores in the two groups

Discussion

Early childhood caries (ECC) affects 48%, nearly half of the preschool children, and its distribution is global. A lower prevalence is observed in Africa compared with the global pooled prevalence, while a higher prevalence is found in Asia, Oceania, and North and Central America. America and Europe are within the global estimate [12].

As a result of ECC, infants, toddlers, and preschoolers suffering from pain lead to poor dietary intake resulting in nutritional deficiencies and life-long complications [13]. Several studies have found that children with ECC have problems with their growth and development, speech disorder, and adverse effect on their permanent teeth. As a result, the children affected are underweight, exhibit erratic sleeping patterns, and exhibit altered behaviour [14]. Also, children with dental caries experience poor performance and attendance at school [15].

Pre-school children are not always willing to cooperate with conventional dental procedures' drill and fill' due to the use of high-speed handpieces, and local anaesthesia tends to induce anxiety in children. So it is preferred to treat caries painlessly, along with a customized behavioural approach for each patient. Therefore, minimally invasive or noninvasive vevnam procedures are strongly recommended for treating children with dental caries [16,17].

In recent years, minimally invasive treatment modalities have dramatically increased. Hall technique and SDF have the advantages of being minimally invasive, child-friendly and non-aerosol generating procedures, so they present alternative options to treat children with barriers to traditional treatment. In clinical practice, they control active carious lesions in the primary molar and prevent further propagation of the lesion [18,19].

Treating the carious deciduous molar in children using the Hall Technique is an internationally controversial but evidence-based new treatment approach. This technique originated in the United Kingdom (UK) in 2007

and is now considered a "Gold Standard" for treating asymptomatic multi-surface carious primary molars by cementing the preformed metal crown (PMC) to seal carious lesions [20]. Hall technique has been chosen in the current study to be carried out on the control group because it has shown a high clinical success rate [11], and it has been well-accepted among parents, children, and dentists [21].

SDF was chosen as the intervention in the current trial because it is one of the most recent and effective materials used in minimally invasive approaches. Furthermore, it showed a higher success rate in arresting dental caries in primary teeth [22]. In addition, The 38% SDF (Riva Star, SDI Limited, Victoria, Australia) is always available on Egyptian markets.

Recommendation for increasing the focus on utilizing MID techniques in managing carious primary teeth as a mainstream option rather than a compromise option. This is when the conventional approach is unavailable due to cooperation or financial considerations. The author found no available data to determine whether the Hall technique was better than the topical use of 38% SDF [9].

Therefore, the current study was conducted to assess the postoperative pain, child's behaviour and child anxiety after treatment with the Hall technique versus silver diamine fluoride with the management of carious primary molars.

To the best of our knowledge, among all literature, this is the first randomized clinical trial conducted to compare silver diamine fluoride and the Hall technique. So postoperative pain, child behaviour and child anxiety were assessed and compared with the results of other studies separately.

In the present study, the selected patients were 4 to 6 years old. This age range was in accordance with [23]. Most children at age 4 develop the ability to cooperate and self-report pain. Therefore, it is essential to choose children with normal intellectual development to express their pain intensity using self-report pain assessment tools (FPSR) [24].

This age range was enrolled in the study because preschool children may lack

cooperation and have an increased risk of future caries, pain, and infections. As a result, this age group may benefit from arresting and sealing active dental caries in the dental clinic without the need for general anaesthesia [25]. Additionally, physiological root resorption of primary molars would not have started or may have been minimal at this age [26].

Hall technique and SDF, the same operator conducted them to avoid individual variations between operators. Following the instructions of the manufacturers as well as previously published studies, all procedures were performed following [27,10,28].

After evaluating tooth shape and occlusion in the HT group, the SSC (3M ESPE, St. Paul, Minn., USA) was checked without fully seating it. Tooth surfaces were cleaned, and then the SSC was loaded with glass ionomer luting cement (Riva Self Cure Capsules, SDI Limited, Victoria, Australia) and positioned partially on the tooth using a finger. The patient bit on a cotton roll and the SSC was fully seated. Excess cement was removed, and postoperative instruction was given [11].

In the SDF group, tooth surfaces were cleaned with gauze and isolated using cotton rolls. The lips and surrounding gingival tissues were protected using petroleum jelly to prevent any irritation or staining before applying 38% SDF (Riva Star, SDI Limited, Victoria, Australia). There was no removal of affected or infected dentin to achieve caries arrest. Bacteria that were killed by silver had a zombie effect by acting as reservoirs of silver which affected healthy bacteria and killed them [29]. A micro sponge brush was used for application. A gentle flow of compressed air was then used to dry the tooth for at least one minute. Following the SDF application, Riva Star KI was applied till the white reactant became clear. The tooth was isolated for up to three minutes, and postoperative instruction was given. Parents were informed that children should not eat or drink for one hour after treatment [10]. The second application was made after 6 months. As a result of applying 38% SDF twice rather than once yearly, the success rate of arresting dental caries increased [22,9].

The Face Pain Scale-Revised (FPS-R) was used to assess postoperative pain, and it is a self-report measure that is a modified version of the original Face Pain Scale. Composed of 6 cartoon faces reflecting the increasing intensity of pain that corresponds to a 0–10 metric pain scale (0 = no pain), (2 = mild pain), (4 = nagging), (6 = miserable), (8 = intense), and (10 = worst). It was designed to place minimal cognitive demands on the child, making it suitable for young children. Studies have demonstrated that children ≥ 4 years of age can understand the scale, and the FPS-R measure has been proven simple, reliable and valid based on research [30].

Postoperative pain follow-up, a form related to pain with FPSR was delivered to the parent, and they were trained to fill the form according to the timetable after 1 day, 2 days, 1 week, 2 weeks, 1 month, and 6 months.

Regarding the results of this study, the statistics of the demographic data showed no statistically significant difference between gender distributions in the two groups ($P= 1$). There was also no statistically significant difference between mean age values in the two groups ($P= 0.073$), as reported similar to Rehim [31]. There was no statistically significant difference between teeth types in the two groups ($P= 0.376$). There was also no statistically significant difference between arch distributions in the two groups ($P= 0.564$). As a result of this methodological feature, the present study guarantees the absence of confounders and confirms the homogeneity of both populations.

Previously, SDF versus HT had not been studied in the literature. So postoperative pain, child behaviour and child anxiety were compared with the results of other studies separately.

In this study, the SDF group showed statistically significantly lower pain scores after one day, two days, and one week than the Hall technique ($P= <0.001$) ($P= 0.010$) ($P= 0.019$), respectively. After two weeks and one month, none of the cases in the two groups had pain.

After six months, SDF showed statistically significantly higher pain scores than the Hall technique ($P= 0.010$). The risk of 1 day postoperative pain is 16% (ARR= -0.16 CI -0.0037 to 0.358) more in the Hall technique compared to the SDF technique; the same result was found at 2 days and 1 week. The risk of 6 months postoperative pain is 25% (ARR= -0.25 CI -0.449 to 0.06) less in the Hall technique compared to the SDF technique.

In the statistical analysis of the postoperative pain changes within the SDF group, Pair-wise comparisons between periods revealed no statistically significant change in pain scores after one day, two days, one week, and one month. At six months, there was a statistically significant increase in pain scores.

In the current study regarding postoperative pain after 2 weeks, none of the SDF group had pain. This result disagreed with Kittiprawong [32], as they found 15% of the SDF group had pain because child participants had more severe dental caries.

The results go in accordance with the results of the study of Tirupathi [33], as they found no pain at one month follow-up in the SDF group.

In the current study regarding postoperative pain after 6 months, 6 teeth (25%) of the SDF group had mild pain (FPSR 2). This result had a higher percentage than Duangthip [34], who stated that 9 teeth out of 222 teeth (4.1%) of the SDF group had pain at 6 months follow-up. In contrast to the previous

finding Rehim [31] stated that 3 teeth (10%) had pain in six months due to failure to arrest the carious lesion, which was attributed to the fact that some children did not correctly follow oral hygiene measures. These results disagree with Tirupathi and Abdulfattah [33,35], who found that all teeth treated with SDF were free of postoperative pain at 6 months follow-up.

In the statistical analysis of the postoperative pain changes within the Hall technique group, Pairwise comparisons between periods revealed no statistically significant change in pain scores after two days, followed by a statistically significant decrease in pain scores from two days to one week to two weeks. There was no statistically significant change in pain scores from two weeks to one month and one to six months.

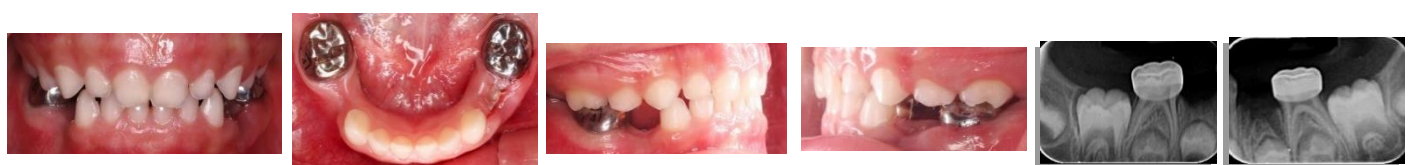
In a study conducted by Ahmed [36], they found a majority of cases in the HT group had mild pain, 16 (57.1%) on day one and 10 (35.7%) on day two, while in the current study, 4 teeth (17%) had nagging pain at first and second day in HT group.

Regarding child anxiety, it was found that there was no statistically significant difference between anxiety rating scale scores in the two groups. However, the mean difference between anxiety rating scale scores in the two groups was (-0.38 with a 95% CI: -1.04- 0.29), indicating that the Hall technique showed higher anxiety rating scale scores than SDF with a value of 0.38.

Preoperative photograph and Radiograph



Postoperative photograph and Radiograph



6 Month

follow-up photographs and radiographs



Figure (8) A five-year-old girl diagnosed with carious lower right primary 2nd molars (LRE) and lower left primary 2nd molars (LLE) was treated with a HT.

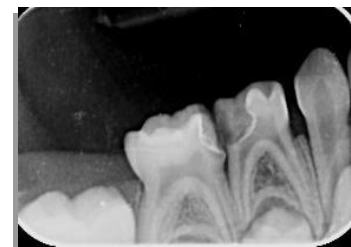
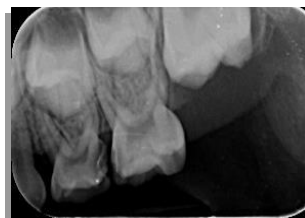
Preoperative photograph and Radiograph



Postoperative photograph



1691



6 Month follow-up photographs and radiographs

Figure (9) A six years old boy was diagnosed with multiple carious primary molars. Upper left 1st and 2nd primary molars (ULD, ULE) and Lower right 1st and 2nd primary molars (LRD, LRE) were treated with SDF.

Conclusion

From the results of this study, the following can be concluded:

- 1- Hall technique didn't show any pain at six months follow-up. This might be attributed to the sealing effect of a full coverage crown which keeps healthy pulpal status.
- 2- Twenty-five percent of SDF cases experienced mild pain at 6 months follow-up. This mild pain might be attributed to the partial loss of the remineralized layer leading to a sensitivity of exposed dentin.

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