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Clinical and Microbiological Evaluation of Smartprep Burs in Caries Removal in Primary Teeth

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ABSTRACT

Purpose: To evaluate the efficacy of smartprep burs in caries removal in primary teeth clinically and microbiologically, also to assess the time taken for caries removal and the pain perception experienced by children compared with conventional carbide burs and sharp spoon excavator. **Subjects and methods:** A total of 51 teeth from children ranging from 4 -9 years old of both sexes, were selected for this study after they met inclusion criteria. The teeth were randomly assigned to three groups, seventeen teeth for each group. The patients were recalled at 1, 6 weeks and 3 months for clinical evaluation. **Results:** Microbiologically the highest mean bacterial reduction was recorded significantly in Group II (conventional carbide bur) (p value > 0.05). While there was no significant difference between Smart burs and spoon excavator (p value =0.9). Clinically the median of caries detector dye scores was significantly lower in the conventional group compared to other groups (p value < 0.05). The mean time for caries removal was significantly different between groups, the highest value was recorded by Smart burs and the least one by conventional burs (p value < 0.05). The median of pain score was insignificantly highest in the conventional group followed by spoon excavator and smart bur had the least value (p value =0.166). **Conclusions:** Smart bur produced great reduction in bacterial count and considered the least painful technique while it took the longest time. It can be used as an alternative to the mechanical method for children but need further studies.

KEYWORDS

Caries,
Minimal Invasive Dentistry,
Smartprep Burs.

INTRODUCTION

Demineralization and remineralization phases of teeth calcified tissues cause dental caries which is an active disease affected by

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biofilm and has different factors such as increased sugar consumption. Although a steady decrease in rates of prevalence in several countries, it still represents a major problem on the health of the community worldwide, so well-designed research, and increased comprehension of its pathogenesis and management are necessary. Decayed lesions of primary teeth are quite a lot condition, affecting nine percent worldwide. Early detection of decayed lesion, evaluation of risk factors, minimal invasive management, and dental tissues protection, are considered types of management of affected dental tissues nowadays [1-3].

Remineralization of the non-infected dentin needs differentiation between the superficial infected and deep non-infected dentinal tissues. Selective removal of the infected dentinal tissues can be performed by different techniques. These methods include air abrasion, Sonoabrasion, chemomechanical caries removal (CMCR), and recent burs (smartprep burs and cera burs) [4].

Some individuals consider caries removal as an unpleasant procedure due to the usage of conventional drills especially children. It causes severe trauma psychologically as it creates an unpleasant aura increasing the fear and anxiety of both parents and children due to which they refuse the treatment. Also, the drawbacks of mechanical methods involve using local anesthesia due to pain, pressure causing trauma to the pulp tissue, heat generation, and vibration, and long procedure time [5].

So, the use of alternative and complementary methods reducing the need for local anesthesia and obtaining minimal or no pain during cavity preparation also contributes greatly to attaining the primary aim of MID. According to the concept of MID, the so-called "4S" principle as a minimally invasive approach in behavioral dentistry is developed. It is based on removing four of the major primary sensory stimuli for dental discomfort when in dental setting – sight (air turbine drill), sounds (mechanical preparation), sensations (great vibrations) and smells [6].

Hand excavation of caries was accomplished as a treatment of choice in raw areas, where facilities cannot be found for prefect management. On the other hand, developed areas began to use similar technique in cases of severe baby bottle decay, in order to control the spread of decay through the fluoride-releasing property of glass ionomers which called Interim Therapeutic Restorations (ITR). In addition, children that are uncooperative and not easy to treat in the dental clinic are suitable persons for ITR, which was more accepted by result [7].

The SmartPrep Burs have shovel-like straight cutting edges and have been designed from substance that is stiffer than decayed dentinal tissues but softer than normal dentinal tissues. It performs a selective removal of decayed dentinal tissues; whereas normal dentinal tissues are not removed (minimally invasive technique); the cutting edges abrade when touches stiffer matters. Smart Prep burs are in the form of three sizes 4,6,8 and used for one time only (self-limiting effect). To prevent touching with the healthy dentinal tissues, they must be applied with light pressure and cavity preparation should be allowed from the central part to the peripheral tissues. Ex: SS White [8].

SUBJECTS AND METHODS

Study design and ethical approval

This secondary care-based three-arm, parallel-group, patient-randomized controlled trial was conducted in the outpatient clinic of Pedodontics Department, Faculty of Dental Medicine for Girls, Al-Azhar University. Research Ethics Committee approval with code **(REC-PE-21-10)** was obtained from Faculty of Dental Medicine for Girls, Al-Azhar University.

Informed Consent

Full details of procedures, possible discomfort and benefits of this study were explained to the parents and informed written consents were signed prior to children enrollment in the study.

Sample size calculation

The calculation was estimated using CDC Epi Info program version 7.2.0.1 (Atlanta, USA) assuming a power of 80% and alpha=0.05 to detect significant difference in efficacy of caries removal (clinical and microbiological) and pain perception experienced by children using smartprep burs, conventional carbide burs and sharp spoon excavator.

A total sample of 42 children's primary teeth (14 each group) was needed based on an estimated mean difference of 7.4±3.6 microbial counts in smartprep burs group compared to 11.7±10.3 in conventional carbide burs group and16.3±3.4 in sharp spoon excavator. To compensate for drop-outs, the sample size was increased by 20%. Then, the minimum estimated sample size was 17 teeth for each group.

Subject Selection

Totally 51 teeth were treated in children ranging from 4-9 years old of both sexes and their parents, were asked to join to the present study after fulfillment of the following inclusion criteria**:** [9]

1. Children should be cooperative
2. Free from any systemic diseases.
3. Teeth selected were primary molars showing comparable cavitated carious lesions with dentin involvement.
4. Teeth should be vital and asymptomatic without clinical evidence of pulp pathosis.

Clinical examination

Before treatment, detailed medical and dental histories were obtained then clinical and radiographic examinations were done (Fig. 1-a). Patient information was collected and recorded in the patient examination chart.

Randomization and Blinding Procedures

Following consent, contributors were consecutively randomized, using a random number list with computer system. The randomly generated sequence was enclosed in sealed envelopes to ensure the allocation concealment. The envelopes were randomly picked up by the children for group allocation. Follow up evaluations were carried out by a calibrated examiner who was not participant in the treatment procedures. There was no blinding.

Study Groups

Fifty-one teeth were irregularly divided to the three groups (Group I, Group II and Group III), seventeen teeth for each group, one or more primary molars in each patient were treated.

Protocols for interventions

With the help of a sterile sharp spoon excavator, the initial sample of the decayed dental tissue was taken from the outer decayed dental tissues (Fig. 1-b). The dentin sample was directly placed into a screw cap vial containing 0.9% sterile saline for microbiological culture of streptococcus mutans. Then, decayed tissue was cut out according to the type of the group.

Group I (Smart bur):

At the polymer bur group, cutting off the carious dental tissues was performed with SmartBurs II (SSWhite Burs, Inc., Lakewood, NJ, USA) size 4, 6, and 8 in accordance with the carious lesion size, running at slow speed without a water coolant and caries was excavated begining from the inside of the lesion to the outside as recommended by the manufacturer (Fig. 1-c). When the instrument edges wore and became less sharp and was no more able to remove dental tissue, the excavation was paused and replaced by new one if needed after verification of decay elimination by an explorer and caries detection dye.

Group II (Conventional carbide round burs):

The decayed dental tissue was cut off by carbide round burs at using low-speed contra-angle. When the soft dentin was no longer detected by the explorer and caries detector dye caries removal stopped.

Group III (sharp spoon excavator):

Carious lesion was cut off using spoon excavator by making circular scooping movement around the instrument axial plane till appearance of sound dentin.

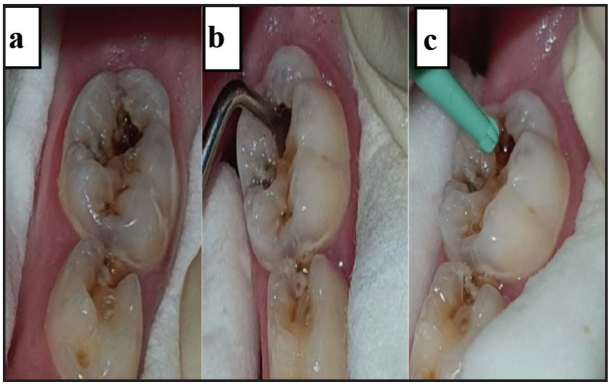

Figure (1) a) Preoperative photo; b) Dentinal sample with spoon excavator; c) Cavity preparation with Smart bur II (SSWhite).

After cavity preparation, by using sterile spoon excavator dentinal sample was selected from the cavity floor deepest portion in all groups and placed inside a screw cap vial containing 0.9 sterile saline. Sufficient amount of dental ships was scratched to perform microbiological culture.

Confirmation of the caries that still present by using caries detector dye (Seek®, Ultradent, Inc., USA) for ten seconds afterwards washing with water for another ten seconds (Fig. 2-a, b). All cavities were conditioned by (Ketac™ conditioner, 3M ESPE, Germany) for 10 seconds, rinsed and restored with resin-modified glass ionomer (EQUIA®Forte HT fill GC Corp., Tokyo, Japan) (Fig. 2-c) then coated with light -cure coat (GC corporation, Tokyo, Japan), then follow-up the restoration for 1, 6 weeks and 3 months for evaluation.

Evaluation

- ***Microbiological Evaluation***

For microorganism culture, pre and post dentinal samples were collected in sterile Eppendorf tubes which had 1 mL 0.9% sterile saline and transported to the lab as soon as possible. Then dilution of the samples at saline, and the inoculum was distributed over the selective media for streptococcus mutans (Mitis Salivarius media).

The inoculated plates incubated for 24 hours at 37°C. After incubation, count plates from each series. Determine the mean colony forming unit per millimeter (CFU/ml).

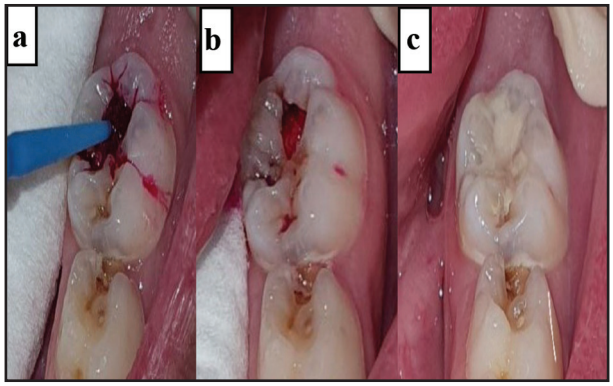

Figure (2) a) Caries detector dye Seek® application; b) The cavity after detector dye application; c) Cavity restoration with EQUIA®Forte HT fill.

- ***Clinical Evaluation of caries:***

Confirmation of the caries that still present by using caries detector dye (Seek®, Ultradent, Inc., USA) for ten seconds afterwards washing with water for another ten seconds. Caries removal efficiency is defined as complete or incomplete and scored by numbers as 0, 1, 2, 3, 4, 5 using caries removal efficiency scoring system criteria (Table 1).

Table (1) *The criteria of caries removal efficiency scoring system*

Score	Definition
0	Caries completely removed.
1	Caries present in the base of the cavity preparation
2	Caries present in the base and/or in one wall of the cavity preparation. and/or two walls of the cavity preparation.
3	Caries present in the base and/or two walls of the cavity preparation.
4	Caries present in the base and/or more than two walls of the cavity preparation
5	Caries present in the base, walls, and margins of the cavity preparation.

Time evaluation

From the start time of elimination of decay, time spent in each technique was recorded in seconds by a stopwatch.

Patient pain and discomfort evaluation

Patient perception of treatment procedure (pain and discomfort) was evaluated using the Wong-Baker Faces Rating Scale (WBFRS) and Verbal Pain Scale (VPS). Participating children were asked to rate pain and discomfort by pointing at the face which was similar to their feeling after each technique. Scoring the scale by putting a value of 0 to the happiest face and 10 to the saddest face (Fig. 3).

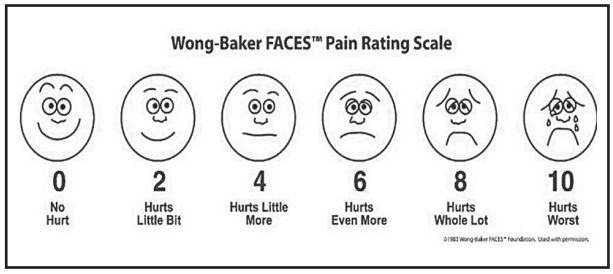

Figure (2)Wong-Baker Faces Pain Rating Scale (WBFPS)

RESULTS

Statistical analysis:

Values were presented as mean, standard deviation (SD) values and confidence intervals. Data were explored for normality using Kolmogorov-Smirnov test of normality. The results of Kolmogorov-Smirnov test indicated that data were normally distributed (parametric data), therefore, Paired t test was used for comparison between value of CFU before and after, while ANOVA and Tukey's post hoc tests was used for intergroup comparisons. The non-parametric data were expressed as median and range and compared using Kruskal Wallis test. Descriptive statistics of qualitative data were presented as frequency and percentage. Chi square test was used for comparisons. The significance level was set at $p \leq 0.05$.

I-Microbiological results:

Percent change (bacterial reduction)

The highest mean percent decrease was recorded in Group II (conventional carbide bur), followed by Group I (smart prep bur), with the least value recorded in Group III (sharp spoon excavator). ANOVA test revealed a significant difference between groups (p=0.001). Tukey's post hoc test revealed no significant difference between group I and III (Table 2)

Table (2) *Descriptive statistics and comparison of percent change in bacterial count (%) in different groups (ANOVA test)*

	Groups	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Min	Max	F	P
					Lower Bound	Upper Bound				
Percent change	Group I (smart prep bur)	-64.22[n]	20.43	4.95	-74.72	-53.71	-100.00	-44.67	8.173	.001*
	Group II (conventional carbide bur)	-89.43[m]	17.64	4.28	-98.50	-80.36	-100.00	-54.52		
	Group III (sharp spoon excavator)	-62.67[n]	26.08	6.32	-76.08	-49.27	-100.00	-28.01		

*Significance level p≤0.05, *significant*

II-Time taken for caries removal (seconds)

The highest mean value was recorded in Group I (smart prep bur), followed by Group III (sharp spoon excavator), with the least value recorded in Group II (conventional carbide bur). ANOVA test revealed a significant difference between groups (p=0.00). Tukey's post hoc test revealed a significant difference between each 2 groups (Table 3).

III- Visual pain score (by Wong-Baker pain Rating Scale)

The highest mean value was recorded in Group II (conventional carbide bur), followed by Group III (sharp spoon excavator), with the least value recorded in Group I (smart prep bur). Kruskal Wallis test revealed no significant difference between groups (p=0.166), (Table 4)

IV- Caries detection with caries detection dye

The highest mean value was recorded in Group I (smart prep bur), followed by Group III (sharp spoon excavator), with the least value recorded in Group II (conventional carbide bur). Kruskal Wallis test revealed a statistically significant difference between groups (p=0.00). Mann Whitney U test was used for pairwise comparison between group I and group III (p=0.133) (Table 5)

Table (3) *Descriptive statistics and time comparison (seconds) taken for elimination of decay in different groups (ANOVA test)*

Groups	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Min	Max	F	P
				Lower Bound	Upper Bound				
Group I (smart prep bur)	481.76[a]	198.99	48.26	379.45	584.08	90.00	780.00	24.655	.000*
Group II (conventional carbide bur)	161.47[c]	49.62	12.03	135.96	186.98	90.00	270.00		
Group III (sharp spoon excavator)	341.47[b]	106.14	25.74	286.90	396.04	105.00	495.00		

*Significance level p≤0.05, *significant*

Table (4) *Descriptive quantitative statistics and comparison of Visual pain score in different groups (Kruskal Wallis test)*

			Visual.Pain.score				Total
			Score 0	Score 2	Score 4	Score 6	
Groups	**Group I (smart prep bur)**	**Count**	12	5	0	0	17
		% within Group	70.6%	29.4%	.0%	.0%	100.0%
	Group II (conventional carbide bur)	**Count**	8	4	4	1	17
		% within Group	47.1%	23.5%	23.5%	5.9%	100.0%
	Group III (sharp spoon excavator)	**Count**	9	7	1	0	17
		% within Group	52.9%	41.2%	5.9%	.0%	100.0%
	P value		0.175 ns				

Significance level p≤0.05, ns=non-significant

Table (5) *Descriptive quantitative statistics and comparison of caries detection with caries detector dye in different groups (Kruskall Wallis test)*

Groups	Mean	Std. Dev	Std. Error	95% Confidence Interval for Mean		Median	Min	Max	P
				Lower Bound	Upper Bound				
Group I (smartprep bur)	1.00[a]	.707	.17	.64	1.36	1	0	3	0.00*
Group II (conventional carbide bur)	.118[b]	.332	.08	-.05	.29	0	0	1	
Group III (sharp spoon excavator)	.647[a]	.606	.15	.34	.96	1	0	2	

*Significance level p≤0.05, *significant, ns=non-significant*

V -Evaluation of restoration

Comparison between groups (intergroup)

At 1 week, 6 weeks**:** all restorations in the 3 groups showed (alpha score), with no difference between groups (p=1). While at Three months**:** all restorations in the 3 groups showed (alpha score) regarding color match, surface roughness, sensitivity, anatomical form and retention; with no difference between groups (p=1).

Regarding marginal adaptation and marginal staining, in group I and group III, 94.1% of cases recorded alpha code and 5.9% recorded Bravo, in comparison to 100% of cases in Group II recording alpha code. There was not statistically significant difference between groups (p=0.59). Regarding secondary caries, in group I, 88.2% of cases recorded alpha code and 11.8% recorded Bravo, in comparison to 100% of cases in Group II recording alpha code. In group III, 94.1% of cases recorded alpha code and 5.9% recorded Bravo. The difference between groups was not statistically significant (p=0.35).

DISCUSSION

Removal of the carious dentin using a high-speed and low-speed hand-piece is considered as mechanical decay elimination method. Although this method improved the cavity preparation efficacy and efficiency, it has a lot of unavoidable drawbacks, such as sense of discomfort and pain by patients, use of local anesthesia, both infected and affected dentinal tissues elimination that results in decreased the bulk of the dental substance, and also harmful generated heat on pulpal tissue and may cause exposure of pulp by dentist [(10-12)].

Appearance of recent techniques of dentistry help to preserve most of tooth structure. The minimal invasive procedure such as polymer burs, allow the infected dentinal tissues elimination, affected dentinal tissues and healthy dental tissues preservation. They also decline the discomfort during the elimination of decayed dentinal tissues using the mechanical methods, and allow dental management to be more comfortable to children [(3)].

So, the aim of this study was to compare the clinical and microbiological efficacy of two minimally invasive methods versus the conventional methods.

Microbiologically in this present study the viable bacterial count mean after decay removal were higher in the polymer bur group compared with that in the carbide bur group significantly. This proves that the efficacy of the mechanical method was more than that of the polymer bur in removal of the decay microorganisms. This is in accordance with the results of recent study [(13)] and also another study[(14)] who got the same results about decay microorganisms.

Although in another recent study [15] there was no significant difference microbiologically between carbide bur (group I) and polymer bur (group II) after removal of decay (p=0.073638). This study showed that polymer burs and carbide burs had the same efficacy in elimination of decay that is in disagreement with the present study. This may be due to this recent study [15] was in vitro, on permanent teeth and bacterial presence was evaluated histologically under light microscope while the present study was in vivo, on primary teeth and the bacteria was evaluated microbiologically.

Other studies agreed with the present study results about working time, all showed that there was significant longer mean working time with Smart bur group than with the conventional group for caries removal [16].

On the other hand, this study was in disagreement with a recent study [13] which found that smart bur has higher working time mean value than conventional carbide bur but with no statistical significant difference.

In the present study the estimation of patient compliance about the dental management was recorded by WBFPS and VPS. There was no statistically significant difference between the carbide and polymer bur groups, and the median of the WBFPS in the conventional group was higher than in the polymer bur group.

On the other hand this study was in disagreement with another recent study [13] who found that the median of the facial image scale scores of pain sensation in the carbide burs group was significantly higher than in the polymer bur group. This means that the participants accepted the procedure with polymer bur than that with the mechanical one which may be due to using painful local anesthesia before procedure with the conventional group.

On the other hand a previous study [17] found that Pain scores using WBFPS were significantly higher for the polymer bur group compared to the hand excavator group (p-value=0.023) this mean that children were satisfied with the hand excavator than smart bur which was in disagreement with the present study.

Detection of decay by caries detector dye in the present research showed that the median of scores in the polymer bur group was significantly higher than that in the conventional group which means that the conventional method is more efficient clinically in removal of decay. Another study [13] in accordance with the present study showed that carbide burs remove decayed dental tissues more efficiently than polymer burs and this may be as a result of the excessive cutting of the cavity.

No significant difference was observed between the polymer bur group and the hand excavation group medians, regarding the caries detector dye scores, this is in disagreement with another previous study [17] that showed a significant higher scores for caries detector dye for the polymer bur group compared to hand excavator group (p-value=0.016).

The elimination of decay efficacy in the conventional method was the highest due to its tendency to cut the cavities excessively because of lack of tactile sensation. Thus, as a result of over preparation by the mechanical method, the cavities prepared appear less stained or not stained by the caries detector dye but healthy dentin, including those adjacent to the dentino-enamel junction, and the demineralized dentinal structure by bacterial metabolites can be stained by caries detector dyes[13].

CONCLUSION

Taking into consideration the limitations of the present study, it was concluded that:

1. Smart burs had antibacterial effect that is nearly similar to hand excavation but still less effective than that of the conventional ones.
2. Smart burs took longer preparation time than that of other techniques.
3. These burs caused the least pain sensation and were the most comfortable method for children.
4. Smart burs can be used as alternatives to conventional approach.

RECOMMENDATIONS

Further clinical, microbiological and histological in vivo studies with larger sample size and longer follow up periods are required to evaluate the outcomes of these minimal invasive technique for managing carious primary teeth and also in vitro studies.

Smart burs are suggested as methods to achieve dental management to children in areas without dental supplies.

CONFLICT OF INTEREST

No conflict of interest.

FUNDING

No funding was received for this study.

REFERENCES

1. Sampaio FC, Böneckerm M, Paiva SM, Martignon S, Filho APR, Pozos-Guillen A, et al. Dental caries prevalence, prospects, and challenges for Latin America and Caribbean countries: a summary and final recommendations from a Regional Consensus. Brazil Oral Res. 2020;35:1–15.
2. Birungi N, Fadnes LT, Engebretsen IMS, Lie SA, Tumwine JK, Åstrøm AN. Caries experience and oral health related quality of life in a cohort of Ugandan HIV-1 exposed uninfected children compared with a matched cohort of HIV unexposed uninfected children. BMC Public Health. 2020;20:1–12.
3. Santos TML, Bresciani E, de Souza Matos F, Camargo SEA, Hidalgo APT, Rivera LML, et al. Comparison between conventional and chemomechanical approaches for the removal of carious dentin: an in vitro study. Sci Rep. 2020;10:1–10.
4. Vusurumarthi V, Ballullaya S V, Pushpa S, Veluvarti VRK, Loka PR, Galla PK. Evaluation and comparison of caries excavation efficacy of three different burs: A micro-computed tomographic-assisted study. J Int Soc Prev Community Dent. 2020;10:213–9.
5. Abinaya R, Nagar P, Urs P, Janani J, Smitha S. Comparing the efficacy of three minimally invasive techniques on demineralized dentin in primary teeth and evaluating its residual dentin and microhardness levels: An in vitro study. Int J Clin Pediatr Dent. 2020;13:585–9.
6. Shindova M. Alternative methods for caries removal. Sci and Youth. 2021;7:307–11.
7. Saber AM, El-Housseiny AA, Alamoudi NM. Atraumatic restorative treatment and interim therapeutic restoration: a review of the literature. Dent J. 2019;7:28–37.
8. Fareen HF, Kandaswamy MDS. Smart materials in dentistry–A review. Int J of Sci Develop and Res (IJSDR). 2021;6:248–89.
9. Ismail MM, Haidar AH. Impact of Brix 3000 and conventional restorative treatment on pain reaction during caries removal among group of children in Baghdad city. J Baghdad Coll Dent. 2019;31:7–13.
10. Maguire A, Clarkson JE, Douglas GVA, Ryan V, Homer T, Marshman Z, et al. Best-practice prevention alone or with conventional or biological caries management for 3-to 7-year-olds: the FiCTION three-arm RCT. Health Technol Assess. 2020;24:1–174.
11. Cardoso M, Coelho A, Lima R, Amaro I, Paula A, Marto CM, et al. Efficacy and patient's acceptance of alternative methods for caries removal—a systematic review. J Clin Med. 2020;9:1–26.
12. Senthilkumar V, Ramesh S. Systematic review on alternative methods for caries removal in permanent teeth. J Conserv Dent JCD. 2020;23:2–9.
13. Asal M, Abdellatif A, Hammouda H. Clinical and Microbiological Assessment of Carisolv and Polymer Bur for Selective Caries Removal in Primary Molars. Int J Clin Pediatr Dent. 2021;14:357–63.
14. Hassan AF, Yadav G, Tripathi AM, Mehrotra M, Saha S, Garg N. A comparative evaluation of the efficacy of different caries excavation techniques in reducing the cariogenic flora: an in vivo study. Int J Clin Pediatr Dent. 2016;9:214–7.
15. Somani R, Jaidka S, Singh DJ, Chaudhary R. Comparative microbiological evaluation after caries removal by various burs. Int J Clin Pediatr Dent. 2019;12:524–7.
16. Praveen Kumar S, Balaji Ganesh S, Sivasamy V. Smart restorative materials used in dentistry-a review. Int J Res Pharm Sci. 2020;11:1–3.
17. Maarouf R, Badr S, Ragab H. Clinical efficiency of polymer burs in caries removal in primary molars and relevant pain perception: a randomized controlled trial. Int Arab J Dent. 2018;9:9–14.