

Comparison of chemomechanical caries removal using Papacárie versus conventional method in children

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ABSTRACT

Purpose: The purpose of this study was to investigate the clinical efficacy of chemomechanical caries removal (Papacárie), compared with the conventional method. **Materials and Methods:** The study consisted of 50 primary molars selected from 25 healthy children (mean age 7.6 ± 1.1). Each patient had at least two primary molars with approximately equal-size caries lesions. Both treatments were carried out in the same session. Before and after treatment, fluorescence values were obtained using DIAGNOdent Pen and time needed for caries removal was recorded. Each patient was asked whether he/she felt any pain, requested for local anesthesia, which treatment he/she preferred, and behavior of the patient during caries removal was assessed. Data were analyzed using McNemar, Wilcoxon signed rank, and Mann–Whitney U-test. **Results:** The clinical evaluation revealed that all the cavities were caries free after both techniques. Comparison of the difference in fluorescence values showed that readings were lower after conventional method ($P < 0.05$). The time taken for chemomechanical caries removal was approximately 2 times longer (t -test). There was no difference between two methods in terms of pain and patient behavior ($P > 0.05$). **Conclusion:** Chemomechanical caries removal and conventional method exhibited similar efficacy in caries removal.

Key words

Dental caries, Papacárie, primary teeth

INTRODUCTION

Traditional means of cavity preparation includes high-speed handpieces and slow rotating instrument and is based on a philosophy of extension for prevention. This method usually induces pain, annoying sounds, and vibration. Furthermore, as a result of removing healthy tooth parts as well as decayed areas, the tooth is weakened and becomes less durable in long-term.^[1,2]

Due to the disadvantages of conventional techniques, restorative dentistry focuses on teeth preservation, and minimally invasive techniques, suggesting new methods for the removal of carious tissue.^[3] Chemomechanical caries removal has been developed as an alternative to the conventional methods.^[2]

In 1975, Habib *et al.*^[4] first introduced chemomechanical caries removal method by using sodium hypochlorite; then it was followed by the introduction of the GK-101 solution.^[5] As a result of studies to improve the efficacy of this solution, in 1985 Caridex system was introduced to the market. However, the product had many disadvantages such as the large volume of solution required, short expiry date, and preheating.^[6] Thus a new material, Carisolv system was launched in 1998. Despite the effectiveness of Carisolv, it had some limitations such as the high cost, the need to certify dental surgeons, and need for special instruments.^[7]

In 2003, aiming to expand the chemomechanical caries removal and promote this technique in the public health area, a new low-cost formula was developed in Brazil which is commercially known as Papacárie (Fórmula and Ação, São Paulo, Brazil).

Papacárie is basically comprised of papain, chloramines, toluidine blue, salts, and a thickening vehicle. These components are responsible for the material's bactericide, bacteriostatic, and anti-inflammatory properties.^[8] The advantages of its use are; easy application and no need for special equipment to be applied.^[9]

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Few studies were done to evaluate Papacarie's efficiency in caries removal in primary teeth.^[10-15] The purpose of this study was to investigate and compare the clinical efficacy of chemomechanical caries removal technique used with the chemical agent; Papacarie, with conventional caries removal technique in primary molars.

MATERIALS AND METHODS

The study consisted of 50 primary molars selected from 25 healthy children aged 6–9 years, who were referred to the Pediatric Dentistry Clinic of Kırıkkale University Faculty of Dentistry, Kırıkkale, Turkey. Each child had at least two contralateral cavitated primary molars with comparable proximal carious lesions. Exclusion criteria were as follows; the patients who were not cooperative and the teeth with the signs and symptoms of irreversible pulpitis, or molars with root resorption that involved more than half of the root length. The study was carried out with ethical committee approval, and the informed consent form was signed by the parent or the guardian.

The study was a clinical controlled trial where the two techniques were compared in the same individual. An independent co-investigator (I.Ş.S) was responsible for randomization. A coin was flipped to decide the treatment type of each tooth. Both treatments were carried out in the same session by one operator (M.E.A). In the study; a pretreatment examination, a dental, medical history, baseline radiographs, caries removal, cavity inspection, restoration, and patient interview steps were followed. For each caries removal technique, the preparation time was evaluated using a stopwatch. When local anesthesia requested by patients, the time was taken including the time required for providing anesthesia.^[16]

Treatment procedures

Before caries removal procedure for each tooth laser fluorescence value was measured using a DIAGNOdent pen 2190 device (Kavo, Biberach, Germany) and recorded. All treatments were initiated without local anesthesia; however, during caries removal if the patient requested, the operator administered the local anesthetic. Cotton rolls and saliva ejector was used for isolation.^[8] The operator randomly assigned each tooth to either of the two methods for caries removal:

Chemomechanical caries removal technique

Before treatment, the Papacarie was taken out of the refrigerator to reach the room temperature. After isolation, the gel was applied to the cavity for about 40 s. The softened decayed dentin was removed by scraping with a conventional spoon excavator. The gel was reapplied until it presented a light coloring, indicative of nonexistence of softened carious tissue. Complete caries removal was assessed using visual-tactile clinical criteria (no tug-back sensation with explorer inspection),

and an independent evaluator (I.Ş.S) who was blinded to the method of caries removal, confirmed complete caries removal.^[17] The cavity was then washed with water spray to remove remaining gel and dentin residues.

Conventional drilling technique

Caries was removed using rotary instruments under water cooling with a spherical bur, which was the largest diameter compatible with the cavity size.^[18] The cavity was checked for remaining caries using the same criteria as above.

After caries removal procedure, laser fluorescence value of each tooth was remeasured using the DIAGNOdent pen and recorded. Then all cavities were restored with Dyract Extra (Dentsply, Konstanz, Germany) according to the manufacturer's instructions.

Patient questionnaire

After complete caries removal, a short interview was used to evaluate whether she or he had felt any pain during the procedure. The options were: No pain, some pain, and unspecified. Furthermore, the preference of treatment was asked to the patient. It was also recorded whether or not the patient requested local anesthesia. The behavior of the patient during caries removal was assessed using the behavior categories of Frankl *et al.*^[19]

- Definitely negative: Refusal of treatment, crying forcefully, fearful, or any other overt evidence of extreme negativism
- Negative: Reluctant to accept treatment, uncooperative, some evidence of negative attitude but not pronounced, that is, sullen, withdrawn
- Positive: Acceptance of treatment, at times cautious, willingness to comply with the dentist, at times with reservation but patient follows cooperatively the direction of the dentist
- Definitely positive: Good rapport with the dentist, interested in the dental procedures, laughing, and enjoying the situation.^[16]

The sample size was determined by modeling other clinical studies.^[20,21] Caries removal time was tested for normality, and parametric statistics was used (*t*-test). Pain during treatment was analyzed using McNemar test. Differences before and after caries removal of laser fluorescence value for each technique were analyzed by Wilcoxon signed rank test, and Mann–Whitney U-test was used for comparison between the chemomechanical caries removal and conventional drilling techniques.

RESULTS

Using visual-tactile clinical criteria, the evaluator considered that all the cavities were clinically caries free after both chemomechanical and conventional caries removal technique.

Comparison of the difference in DIAGNOdent pen readings before and after caries removal between the two methods by the Mann–Whitney U-test showed that laser fluorescence values were affected more by conventional caries removal technique than chemomechanical caries removal technique [$P < 0.05$, Table 1].

Papacárie and conventional treatment groups differed significantly in the average time for complete caries removal ($P < 0.05$). The mean time $\pm$ standard deviation for the conventional treatment group was 3.15 ± 2.20 min whereas for Papacárie group the mean time was 7.56 ± 2.73 min [Table 2].

After the treatment was completed, patients were asked if they had felt any pain during caries removal. In Papacárie group, 16 (64%) patients have reported some pain and in conventional treatment group some pain was reported by 13 (52%) patients. There is no statistically significant difference between the groups ($P > 0.05$).

During caries removal with Papacárie, no patient requested the use of local anesthesia (0/25); whereas during conventional caries removal local anesthetic was administered to four patients (4/25). However, these results did not allow further statistical analysis.

When the behavior of the patients during caries removal was assessed, for both techniques no patients showed “very negative” behavior. “Positive” behavior was seen in 13 patients (52%) during the chemomechanical treatment with Papacárie but 2 (8%) of these patients had “negative” behavior during conventional treatment. Seven patients (28%) had “very positive” behavior with Papacárie and 10 patients (40%) with the conventional method [Table 3]. After caries removal procedure, when the patients were asked about the treatment preference, 16 patients (64%) reported that they have preferred conventional treatment [Table 1].

DISCUSSION

Previous *in vivo* and *in vitro* studies evaluating Papacárie have reported that the material is easy to manipulate, clinically efficient and biocompatible.^[1,2,7,8,22,23] Also in the studies comparing Papacárie and Carisolv, two materials have shown similar results.^[20,24,25] In several case reports, the authors have recommended the use of Papacárie in Pediatric Dentistry and the material has been considered as an alternative to conventional treatment for removal of caries.^[10,15,26,27] However, there are few clinical studies have evaluated the efficiency of Papacárie compared with conventional treatment.^[12,14,15] The present study was conducted for comparative evaluation of the clinical efficiency of Papacárie and conventional treatment in primary teeth.

Table 1: DIAGNOdent pen values before and after caries removal procedure

Groups	n	DIAGNOdent pen values (mean (SD))	
		Initial	Final
Conventional caries removal	25	94.6 (9.2) ^a	7.4 (7.1) ^b
Chemomechanical caries removal (Papacárie)	25	94 (8.2) ^a	15.9 (8.1) ^c

*Different superscript letters show significant differences between groups ($P=0.003$). SD – Standard deviation

Table 2: Background, tooth and treatment characteristics of subjects

	Papacárie	Conventional treatment
Mean age	7.64	7.64
Sex (male/female)	12/13	12/13
Primary tooth location (mandibular/maxillary)	18/7	17/8
Use of local anesthesia	0/25	4/25
Treatment time (mean (SD)) (min.)	7.5 (2.7)	3.1 (2.2)
Preference of treatment	9/25	16/25

SD – Standard deviation

Table 3: Patient behavior during caries removal procedure^[8]

Conventional treatment	Papacárie				Total <i>n</i> (%)
	Very				
	Negative	Negative	Positive	Positive	
Very negative	-	-	-	-	-
Negative	-	1	2	-	3 (12)
Positive	-	3	8	1	12 (48)
Very positive	-	1	3	6	10 (40)
Total <i>n</i> (%)	-	5 (20%)	13 (52%)	7 (28%)	25 (100)

In previous *in vitro* studies, which have evaluated the performance of laser fluorescence for residual caries detection in primary teeth after different caries removal methods, the authors reported that laser fluorescence system could be effective in checking the removal of caries by different methods.^[24,28] In the present study, after conventional and chemomechanical caries removal, all the cavities were considered to be clinically caries free. However, when DIAGNOdent pen measurements (laser fluorescence values) were evaluated, the conventional technique was found to be more efficient than Papacárie for complete caries removal ($P < 0.05$). The reason might be related to fluorescence values, which are highly affected by staining dentin. Neves *et al.* have reported that staining in residual dentine accounts for significantly higher laser fluorescence measurements.^[29] Because Papacárie is much less effective in chronic lesions, as mentioned in the manufacturer instructions; DIAGNOdent pen measurements would have been higher

in Papacárie excavated lesions. The residual dentin of Papacárie excavated lesions would have had more staining dentin but not infected tissue.

In a previous study, comparing laser fluorescence values for residual caries after different caries removal methods, the authors have found lower fluorescence values in conventional method than chemomechanical group similar to our study.^[28] However, Corrêa *et al.*^[24] who compared fluorescence values of remaining dentine after caries removal using conventional and chemomechanical techniques with Carisolv and Papacárie *in vitro*, have reported that fluorescence values were similar between all groups. In another *in vitro* study, Jawa *et al.*^[2] have evaluated the efficacy of Papacárie and a conventional method for complete caries removal histologically. They have stated that complete caries removal was achieved significantly in both of the methods. Contrary to Jawa *et al.*,^[2] Yazici *et al.*^[30] in their *in vitro* study, have stated that conventional rotary instrument was more effective than Carisolv in the removal of carious tissue. Maragakis *et al.*^[20] have reported that chemomechanical treatment with Carisolv was much slower than rotary instruments and was not effective as rotary instruments for caries removal because in their study, one-third of the samples decay was not removed completely in <15 min.

Laboratory studies concluded that papain based chemomechanical caries removal techniques did not influence the bond strength of adhesive systems.^[22,23] Based on these results, follow-up of the patients continues for the longevity of restorations with chemomechanical caries removal technique.

Numerous studies have been conducted evaluating chemomechanical caries removal with Carisolv material, and most of these clinical studies have reported that reduction of pain and the lack of need for anesthesia provides positive behavior of the patients.^[16,31-33] However, the important shortcoming of this method is that the treatment is more time-consuming.^[16,17,30,32,33] In the present study, Papacárie and conventional treatment groups differed significantly in the average time for complete caries removal (*t*-test). The time needed for chemomechanical caries removal is almost 2 times longer than the conventional treatment time. This result is similar to previous studies.^[10,24,27,31,33,34] However, Kotb *et al.*^[12] have stated that there were no significant difference in the operating time between chemomechanical method using Papacárie and the conventional method.

Previous clinical studies have reported that patients felt less pain with the chemomechanical caries removal compared to conventional method.^[8,10] In our study, there was no statistically significant difference between two methods in terms of feeling pain during caries removal procedure ($P > 0.05$). When evaluating patient behavior during treatment, more patients (88%) have

shown positive behavior during conventional caries removal, and 64% of the patients reported that they have preferred conventional treatment. Although there is no significant difference between two methods in terms of pain, one of the reasons of a higher proportion of preference for conventional treatment could be the result of longer treatment time required for chemomechanical treatment. Long chair time decreases the child's compliance to the treatment.^[17] In the present study, despite no significant difference between two methods in patient behavior, number of patients with positive behavior (88%) in conventional treatment is more than in the chemomechanical treatment (80%).

In a clinical study, Carrillo *et al.*^[7] have reported that Papacárie gel is well accepted by disabled children. Also in previous case reports, the authors have recommended the use of Papacárie in Pediatric Dentistry and the material has been considered as an alternative to conventional treatment.^[10,11,15,27,34] However, in the present study, considering pain degree and patient behavior we could state that there is no direct clinical advantage of Papacárie over the conventional method in conventional dental office conditions. There are several clinical studies reporting similar results with this study.^[17,35] Inglehart *et al.*^[17] and Peters *et al.*^[35] have reported that chemomechanical caries removal method needed more clinical effort, and it was more time-consuming than conventional method. Also, they have stated that fear of the dentist of patients decreased in conventional method, and there was no significant difference between the number of patients who needed local anesthesia during chemomechanical and conventional caries removal. According to the results of the present study, maybe there is no clinical advantage of using papacarie in the conventional dental office, but in places where no access available to dental equipment chemomechanical caries removal could be advantageous, therefore, the importance of chemomechanical caries removal should not be forgotten in rural places.

CONCLUSION

Although most of the studies evaluating chemomechanical and conventional caries removal have stated that chemomechanical caries removal could be an alternative to conventional method; according to the results of our study using laser fluorescence measurements conventional technique was found to be more efficient than Papacárie for complete caries removal. It could be stated that there is no clinical advantage of using Papacarie in conventional dental office over conventional method.

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