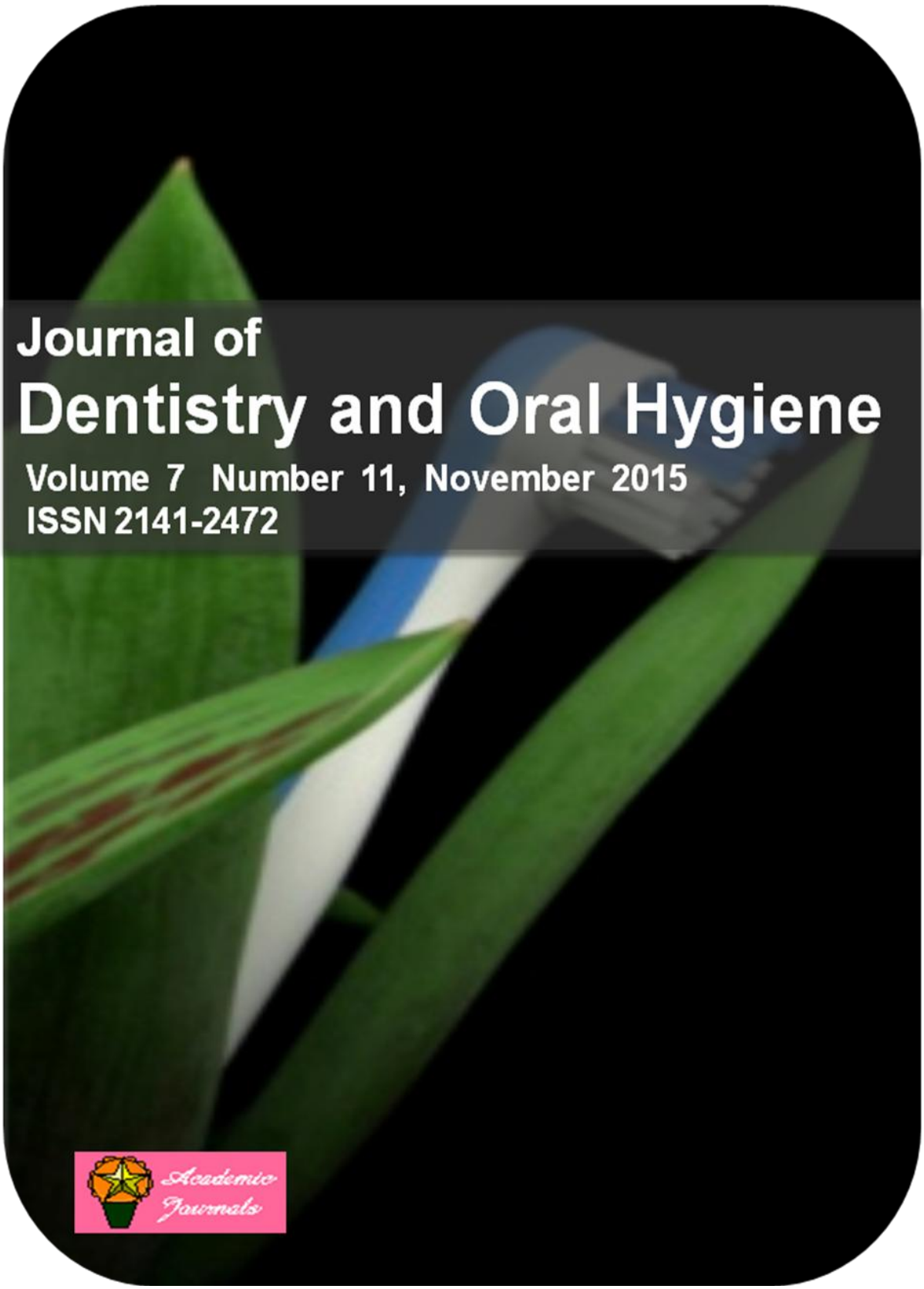

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Full Length Research Paper

Prevalence of untreated dental caries among the preschool children of Western Maharashtra

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Optimum oral health is required to eat, socialize without discomfort or embarrassment. Untreated dental caries is a common problem faced by the population in developing countries affecting the development of the child. A cross sectional study was conducted among 3 to 5 years old preschool children to evaluate the prevalence of dental caries and consequences of untreated dental caries. Dental caries was measured using 'dmf' and 'pufa' index. Descriptive statistics was computed to assess the prevalence of the untreated dental caries. Chi square test and z test were used to assess the statistical difference among the variable means in between the groups. Data was analyzed using SPSS ver 20.0. The prevalence of dental caries in the study population was 32% and that of the untreated dental caries with clinical consequences was 24%. There was no statistically significant difference between the genders for prevalence of untreated dental caries. The mean 'dmf' and 'pufa' scores increased over the ages of 3, 4 and 5 years in the study sample. 'pufa' index can be used as a useful epidemiological tool to assess the prevalence of untreated dental caries. Proportion of untreated dental caries was substantial which points to the need for diverting attention to care of deciduous dentition.

Key words: Untreated dental caries, 'pufa', preschool children.

INTRODUCTION

Despite the developments in the field of caries prevention and treatment, dental caries continues to remain a frequent phenomenon in the infants and children of developing countries (Kim, 2012). Dental caries causes pain, impairs eating, sleeping, local and systemic infections and affects the quality of life of the affected individuals (Chu, 2000; Bönecker et al., 2012).

Many studies have reported with varying caries prevalence in the 3 to 5 year old old preschool children, ranging from 40% to as high as 90% in various countries. In India, National Oral Health Survey conducted in 2004 reported 51.9% prevalence of caries in 5 year old children (Bagramian et al., 2009). A study conducted by Mahejabeen et al. (2006) in Hubli and Dharwad city, India reported the caries prevalence in children of 3, 4 and 5 year old as 42.6, 50.7 and 60.9%, respectively. Similarly,

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a study by Simratvir et al. (2009) in Ludhiana city showed a dental caries prevalence of nearly 51% among the 3 to 5 years old children.

The Federation Dentaire Internationale World's Dental Federation's Oral Health Atlas recently estimated that untreated dental caries affects more than half of the children in most South East Asian countries (Beaglehole et al., 2009).

During the last decade, dmf index has been the index of choice in the epidemiological surveys to assess the caries burden and restorative needs of various populations, but has been found to be incapable of diagnosing all stages of caries (Frencken et al., 2011; Ismail, 2004; Honkala et al., 2011). To overcome this drawback, various indices like International Caries Detection and Assessment System, Caries Assessment Spectrum and Treatment Index and PUFA/pufa index have been developed (International Caries Detection and Assessment System, 2005; Monse et al., 2010).

PUFA/pufa index by Monse et al. (2010) measures the consequences of untreated caries process and helps in quantification and communication of the untoward outcomes of oral diseases. The PUFA/pufa index comprises P/p denoting the pulpal involvement, U/u the ulceration of soft tissues, F/f the presence of fistula and A/a the abscess as a measure of advanced carious lesions (Pine et al., 2006).

Such advanced carious lesions or odontogenic infections influence the state of general and oral health of the child. Pine et al. (2006) suggested that by non-treatment of dental caries in deciduous teeth, particularly where many teeth are affected, the risk of occurrence of dental sepsis is increased (Bönecker et al., 2012).

The studies assessing the prevalence and consequences of untreated decay in the pre-school children are few. Few studies have reported caries prevalence among the preschool children in India (Mahejabeen et al., 2006; Mahejabeen et al., 2012; Priyadarshini et al., 2011; Tyagi, 2009; Sachit et al., 2012). Hence, this study was conducted with a dual aim to assess the prevalence of carious lesions and prevalence of clinical consequences of untreated carious lesions among the preschool children of Karad city, western Maharashtra, India.

MATERIALS AND METHODS

This was a descriptive cross-sectional study conducted from January to March, 2014 among 3 to 5 years old preschool children of Karad city, Maharashtra, India. Prior to the initiation of the study, ethical approval was obtained from institutional ethics committee and the study was conducted according to the ethical guidelines.

Study settings

Karad is a town situated in Satara district, western Maharashtra, India with an average population of around 75,000. Children below 6 years constitute 11% of this population (Census of India, 2001).

The present study was conducted in randomly selected pre-schools of this area and the total participants of the study were 300 children between the ages 3 and 5 years. The sample size was computed to be 260 based on the prevalence of 50%, precision of 90% and error of 5%.

List of pre-schools in the study area were obtained from the Department of School Education office. From the list of pre-schools, two schools were selected by systematic random sampling, from which children were selected by simple random sampling technique.

Inclusion and exclusion criteria

Informed consent was obtained from parents and permission was sought from concerned authorities. Children present on the day of examination, with positive parental consent and who were co-operative for clinical examination were included in the study. Medically compromised children and those who were absent on the day of examination were excluded from the study.

Clinical examination

A trained and calibrated examiner measured the caries using dmf index and pufa index. To measure dental caries dmf was used (Gruebbel, 1944) and to measure untreated dental caries pufa index was used by Monse et al[11]. Examiner was trained and calibrated at the dental unit of Department of Public Health Dentistry, India and kappa was calculated to be 0.8 and 0.86 for both indices indicating high degree of conformity.

'dmf' index includes decayed, missing (missing due to caries) and filled teeth components to assess the caries experience for deciduous dentition. Similarly, pufa index includes the components: pulpal (p), open pulp chamber is visible or the caries process destroyed the tooth crown leaving the roots; ulceration (u), sharp edges of a tooth with pulpal involvement caused a traumatic ulceration of surrounding, e.g. lingual or buccal mucosal tissues; fistula (f), the presence of an active fistula related to a tooth with pulpal involvement; abscess (a), oedema of soft tissues related to a tooth with pulpal involvement.

The clinical examination was carried out on dental chair under adequate illumination. Only a visual assessment, without the use of a dental probe, was carried out to assess 'pufa' index and for 'dmf' assessment mouth mirror and dental explorer were used. In case of the presence of debris which impeded the examination, tweezers and cotton was used to clean the surfaces of the teeth.

Statistical analysis

All the data was compiled and summarized. Descriptive statistics was computed to assess the prevalence of the untreated dental caries and chi square test and z test were used to assess the statistical difference among the variable means in between the groups. The data was analyzed using SPSS ver 20.0 and P value was set at <0.05 as significant.

RESULTS

Of the total sample of 300, 158 were males (52%) and 142 were females (48%). The mean age of the participants was 4.3 ± 0.8 years (Table 1).

Table 1. Distribution of the participants according to the age and gender.

Age (in years)	Male (%)	Female	Total
3	26 (60.4)	17 (39.5)	43 (14.33)
4	98 (50.51)	96 (49.48)	194 (64.66)
5	34 (53.96)	29 (46.03)	63 (21)
-	158 (52)	142 (48)	300 (100)

Table 2. Distribution of the study participants according to the prevalence of dental caries.

Parameter	Male		Female		Total		dmf score [Mean ± SD]	pufa score [Mean ± SD]
	Caries [n (%)]	Caries free [n (%)]	Caries [n (%)]	Caries free [n (%)]	Caries [n (%)]	Caries free n (%)		
3 years	05 (19.3)	21	06 (35.1)	11	11 (25.5)	32	1.9±0.23	0.12±0.00
4 years	26 (26.5)	75	38 (39.5)	63	64 (32.98)	130	2.52±0.48	1.47±0.28
5 years	09 (26.4)	22	12 (41.3)	14	21 (33.3)	42	2.67±0.62	1.64±0.56
Total	44	118	52	90	96 (32)	204	2.57±0.56	1.56±0.40
Mean dmf score	2.45±0.22	-	2.64±0.22	-	2.57±0.56	-	-	-
Mean pufa score	1.42±0.12	-	1.58±0.43	-	1.56±0.40	-	-	-

The mean dmf score for the sample was 2.57 ± 0.56, the mean d component was 2.57 ± 0.56 and mean m and f component were 0.00. The mean 'pufa' scores and mean 'p' score for the sample was 1.56 ± 0.40 each, 'u' and 'f' scores were 0.00 and 'a' score was 0.11 ± 0.01.

There was no statistically significant difference between the mean dmf and pufa scores for the genders. There was a statistically significant difference between the ages for mean pufa and dmf scores (Table 2).

Nearly 32% of the study sample was presented with carious lesions. Prevalence of clinical consequences of untreated dental caries was 24% of sample as measured using 'pufa' index. Pufa ratio was found to be 34%.

DISCUSSION

In our sample, the prevalence of dental caries was found to be 32%. These findings were comparable with those of studies by Shilpashree and Ramakrishna (2013) in South India which reported prevalence of 31.4%, while Bian et al. (2000) in China reported a prevalence of 36%. On comparison with the results of the National Oral Health Survey, the prevalence reported in this study is considerably lower (Bagramian et al., 2009).

Similarly, caries prevalence reported in this study is less compared to that reported in studies in Penaflor, Chile 56.8% (López et al., 2009), Northern Philippines 59 to 92% (Carino et al., 2003), China 60%, Japan 60 to 77%, and Thailand was 62% and Hong Kong was 63% (Bagramian et al., 2009).

In this study, prevalence of pufa codes was 24%. This was less than that observed in other studies by Mehta and Bhalla (2014) (38.6%), Monse et al. (2010) in Philippines (85%) and Bagińska et al. (2013) among Polish children (43.4%).

"p" component of pufa formed majority of the total score. These findings are comparable to studies reported earlier (Monse et al., 2010; Mehta et al., 2014; Bagińska et al., 2013; Figueiredo et al., 2011).

In this study, very few cases of other components of pufa like abscess were observed. This further substantiates the need to modify the index by eliminating 'u' and combining 'f' and 'a' components (Figueiredo et al., 2011).

Mean pufa value was reported to be 1.56 ± 0.45 and it was less than that reported by Monse et al. (2010) among 6 year olds, which was 3.4. But the mean pufa value of our study was higher than that reported by Mehta and Bhalla (2014) (0.9) in Chandigarh 2014, Figueiredo et al. (2011) Brazil (0.4) and others.

No statistically significant difference was found between the mean 'pufa' and 'dmf' scores for genders, which is contrary to other studies which observed higher prevalence of 'dmf' scores in females attributing to its early eruption patterns. Yet the mean scores for females were consistently slightly higher as compared to males as observed in various studies by Shilpashree and Ramakrishna (2013), Carino et al. (2003) and Davenport et al. (2004).

On the contrary, the mean 'dmf' and 'pufa' scores increased significantly over the ages of 3, 4 and 5 in the present sample. This can be attributed to the increasing exposure to oral environment and transitioning food

habits.

High prevalence of untreated dental caries was observed in our study. Such untreated dental caries burden among children can lead to pain, sepsis, space loss, disruption to quality of life, disruption of growth and development (failure to thrive), possible disruption of intellectual development, higher incidence of hospitalization and emergency visits, increased treatment costs and treatment time, greater risk of new carious lesions in both primary and permanent dentitions along with secondary effects as increased parental stress, loss of work days, disrupted school learning among others (Finucane, 2012).

Conclusion

In this study, the proportion of untreated dental caries was high which points to the need for diverting attention to care of deciduous dentition. Similarly, the impact of untreated caries on health and missed learning opportunities can be an advocacy talking point for the policy lawmakers and legislators to shed light on the need to prioritize dental care among pre-schoolers and children so that improving children's oral health status may be a vehicle to enhancing their educational experience.

Conflicts of interest

The authors declare that they have no conflict of interest.

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Full Length Research Paper

An evaluation of ethical aspects concerning endodontic instrument fracture

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The aim of this study was to address and analyze several ethical issues relating to the behavioral conduct of general practitioners and endodontists towards instrument fracture during root canal treatment. Data was collected from a group of general practitioners and endodontists and other specialist from other field who perform root canal treatment, using an open ended questionnaire, which was later reviewed and analyzed statistically using chi-square test. 88% of the respondents claimed to have encountered instrument fracture. 59.1% of the participants affirmed that they would inform the patient in case of an incident. 23.4% claimed to refer the case to an endodontists. The results of this survey indicated that most of the professional are still hesitant from informing the patient about the incident that occurred. This may be due to the fear that it might affect their day to day practice.

Key words: Ethics, endodontists, files, procedural accident.

INTRODUCTION

Dental ethics is a systemic study of what is right and good with moral principles or virtues that governs the character and conduct of an individual or group (Weinstein, 1993). A clinician may encounter procedural errors and obstacles like a fractured instrument inside the root canal during routine endodontic practice which may alter the course of treatment (Torabinejad and Lemon, 2002). A fractured endodontic instrument during a non-surgical root canal treatment is a recognized complication, which is frequently considered to be a failure of the treatment. Fracture of the instrument does not affect the objective of endodontic treatment. Prognosis of the treatment should be determined with the time of fracture during treatment and by the presence of infection in the canal. Fracturing a file during endodontic treatment is not a malpractice, but it is professional and ethical to inform the patient about this (Kia, 2013). Procedural accidents or failures during endodontic treatment usually excite the patient due to their fear of treatment becoming a failure. Thus, it would be appropriate to inform the patient about the incident, its consequences, treatment plan, and prognosis for a proper cooperation to complete the case. However, very few studies on instrument fractures and its management have assessed the ethical conduct by dentists and specialists.

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Therefore, the aim of this article is to address the ethical aspects of dentist's behavior towards endodontic instrument fracture, as this is a main concern relating to the success of endodontic treatment. This study addresses several ethical aspects regarding the behavior of general practitioners, endodontists and other specialists regarding instrument fracture during root canal therapy.

MATERIALS AND METHODS

The study was registered with the research centre of Riyadh Colleges of Dentistry and Pharmacy and was given the registration number FRP/2015/144.

Sample selection

All the hospitals, both government and private clinics in and around Riyadh Kingdom of Saudi Arabia, were chosen.

Design

An open ended questionnaire was modified and framed, based on one used by Rhonan et al. (2008). The questions assessed the ethical aspects of dentists and specialists conduct in endodontics. A form stating the confidentiality of the data and their usage for research purpose only was also filled out.

Three hundred and fifty questionnaires were distributed to dentists and specialists in the city of Riyadh, KSA. The questionnaires were distributed in person to all the doctors by 2 investigators. The questionnaires were filled and returned back to the investigators. The collected data was reviewed and analyzed statistically by Statistical Package for Social Sciences (SPSS) software Version 18. The level of significance was set at $p<0.05$. The null hypothesis was that there was no association between the variables assessed in the questionnaire.

RESULTS

From the total of 350 questionnaires, a response rate of 86.5% (n=303) was obtained. Based on the data collected from the responses, it was observed that 62% (n=190) of the respondents were general practitioners, 28% (n=87) were endodontists, 8% (n=26) were specialists from other field who perform root canal treatment in their practice (Table 1).

With regards to the question on incident of instrument fracture, 88% (n=267) of the respondents affirmed that they do have instrument fracture in the canal. When a correlation was made between area of specialization or professional qualification and instrument fracture, it was found out that 87% (n=167) of general practitioners and 93% (n=81) of endodontists, have already experienced instrument fracture (p=0.021), the other 19 participants were specialists from other field performing endodontic treatment (Table 2).

When questioned about the first act of occurrence of instrument fracture, 23% (n=72) respond they would inform the patient about the accident and continue the treatment and 22.4% (n=68) responded they will try to solve the issue without informing the patient. And 35.3% (n=107) will inform the patient about the accident and finish treatment in another appointment (Table 3).

A statistical analysis by Pearson chi-square, showed a significant association (p=0.007) between professional qualification and ethical conduct (informing or not informing the patient and first treatment). A significant difference was found between the area of specialization or professional qualification and referral case to an endodontist (p=0.000). 27.8% of general practitioners (n=53), would refer the case to an endodontist. In case of failure to remove the fractured segment, 80% of the endodontist would inform the patient and finish the treatment in another appointment. Thus, the null hypothesis was rejected, because of the statistical significant difference between the variables in the questionnaire.

When questioned about saving or preserving a broken or defective instrument removed from canal, 28.5% (n=57), answered yes, they would save the broken or defective files. A statistical difference (p=0.000) was found between the professional qualification and saving the broken file. 8% (n=7) of the general practitioners and 45% (n=38) of the endodontists and 38% (n=12) of the practitioners from other specialties preserve the broken files.

DISCUSSION

Informing the patient preoperatively of the options and risks of root canal treatment as a part of consent procedure is an important step in good clinical practice. Theoretically, therefore, every patient undergoing root canal treatment or retreatment should be warned of the possibility of file fracture. However, it is questionable as to whether this happens in real practice today. Hence, in the present study, it was evaluated and reviewed whether the doctors both general practitioners and specialists, do follow the correct ethical aspects concerning endodontic instrument fracture. Generally, the incidence of instrument fracture is reported to be relatively low (0.7 to 7.4%) (Crump and Natkin, 1970; Parashos and Messer, 2006; Bergenholtz et al., 1979; Pettiette et al., 2001; Spili et al., 2005). However, the occurrence of this can lead to problems between the patient-doctor relationships. On analysis of the results in the present study, it was found out that among the endodontist, 93% affirmed to already have an experience of fractured instrument. This is in accordance with the statement by Cohen (1988), that even the most careful and skilled dentist can fracture an endodontic file during root canal preparation eventually. A fractured instrument pose a challenge to every dentist

Table 1. Area of specialization.

Variable		Frequency	Percent	Valid (%)	Cumulative (%)
Valid	General practitioner	190	62.7	62.7	62.7
	Endodontist	87	28.7	28.7	91.4
	Specialists in other fields	26	8.6	8.6	100.0
	Total	303	100.0	100.0	-

Table 2. Do you encounter with instrument fracture.

Variable		Do you encounter with instrument fracture		Total
		Yes	No	
Area of specialization	General practitioner	167	23	190
	Endodontist	81	6	87
	Specialists in other fields	19	7	26
	Total	267	36	303

Table 3. Frequency of professional qualification when related to the act in case of instrument fracture.

Variable	Inform patient and finish in another appointment	Inform patient and continue the treatment	Try to solve without telling the patient	Refer to endodontist	Will not inform the patient and finish treatment
P	0.000	0.000	0.000	0.000	0.000
General practitioner	23 (12.1%)	11 (5.7%)	12 (6.3%)	53 (27.8%)	8 (4.2%)
Endodontist	69 (79.3%)	45 (51.7%)	38 (43.6%)	2 (2.2%)	30 (34.4%)
Other specializations	15 (57.6%)	16 (61.5%)	18 69.2%)	16 (61.5%)	16 (61.5%)

whether a general practitioner or a specialist. The probability of an occurrence is linked to the difficulty of each case and to the practitioner's skill and experience (Kia, 2013). In an event of instrument fracture, the patient should be informed about what has occurred. A pre-warning of the possibility of instrument fracture was given; thereby making this explanation becomes much easier. An excuse or apology made by the dentist is not an admission fault, but rather, acknowledgement of the concern and inconvenience the mishap may cause to the patient. In addition, the patient should also be informed about the case sequence and prognosis of the treatment (Leite, 1962; Cohen, 1988; Imura and Zuolo, 1988). In the present study, an analysis on the decision of informing the patient in occurrence of an instrument fracture, it was found out that only 8% of the general practitioners will not inform the patient about the incident and an higher rate was found among the endodontist (30%). Still, whether a general practitioner or a specialist, it is mandatory to follow the ethical conduct to inform the patient about the incident (Leonardo and Leal, 1998). It is therefore necessary to find the right explanatory words and fulfill our ethical obligations without worrying the patient unnecessarily. This information must take into account the following factors: the timing of the fracture during treatment; the level of contamination of the canal prior to treatment; and the degree to which the instrument will compromise the seal of the canal (Simon et al., 2008).

With regards to the ethical behavior, if the fragment could not be removed, results indicated that 12.1% of the general practitioners and 79.3% of endodontist would inform the patient and continue in another appointment. These findings demonstrate that after an unsuccessful attempt of fractured instrument removal, treatment was continued in another appointment, which avoids any delayed appointments and increased physical and emotional stress to the patient.

An essential skill of risk management is the ability to know when a case is beyond your level of expertise. To achieve this evaluation, the potential risks involved was assessing the case preoperatively and to analyze whether you can successfully complete the case and mainly whether the patient will be served better by your care. It is always preferable to refer a case if you feel it is beyond your expertise, before initiating treatment, which can in turn reduce the likelihood of malpractice claim. In the present study, referral to an endodontist was found to

be higher by the general practitioners (27.8%), which is in accordance with the earlier study by (Ree et al., 2003). In a survey held amongst general practitioners (Saunders et al., 1999), it was shown that the decision to refer was influenced by certain factors. For example, the presence of a perforation was considered an important factor to refer by 87.1% of the respondents, followed by the need for retreatment (76%) and periradicular surgery (73.8%). With regards to saving or preserving the broken or defective instrument, it was found out that most of the practitioners do not do this. In occurrence of a claim, the instrument manufacturer may be liable, because the product was defective, rather than the clinician being liable for the dental negligence. Electron microscopy spectrographic analysis can determine if manufacturer defect with contaminants caused the breakage, rather than the clinician excessively stressing the instrument (CAN Health Pro, 2005).

The risks of file separation can be reduced by carefully inspecting files on a frequent day to day basis. Assuming proper techniques were used, instrument fracture is not considered a dental malpractice. It is the dentist's immediate response to the fractured files that determines whether the standard care protocol has been met. Most of the lawsuits results from the dentists failing to inform the patient about the separated file.

Conclusion

If the clinician performs endodontic treatment within the standard of care, there should be little concern that a lawsuit for professional negligence will be successful.

Endodontic instrument fracture may bring forth problems to patients and dentists, in different ways. Immediate notification of such an occurrence to the patient is a desired and proper conduct to be followed by dentists. The best way to prevent lawsuits in Dentistry is having an ethical and clear attitude towards the patient mainly in situations involving accidents related to dental treatment. It is also necessary to keep accurate and updated dental records (e.g. radiographs, contracts, prescriptions, casts).

The results of this survey based study indicated that most of the professionals are still hesitant from informing the patient about the incident occurrence. This may be due to the fear that it might affect their day to day practice.

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Conflicting interest

The author declares no conflict of interest.

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Full Length Research Paper

Evaluation of resistance to fracture of temporary implant-supported prosthesis with extension in cantilever enhanced with glass fibre

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This study aims to evaluate the fracture resistance of acrylic resin used in temporary prosthesis with an extension cantilever, using glass fibers treated with silane as reinforcement, varying the distribution and positioning within the matrix. Fifty specimens were produced and divided equally into five groups: Group I, without reinforcement; Group II, reinforced with continuous, concentrated and aligned fibers; Group III, enhanced with simple fiber laminate; Group IV, a doubly reinforced fiber laminate; Group V, reinforced with fibers surrounding the implants and parallel to the occlusal surface. There was statistical variation between Groups I and III, I and IV, I and V, II and III, II and IV, II and V, and III and IV. The results demonstrated that temporary prosthesis reinforced with glass fibers treated with silane exhibited an increased resistance to fracture.

Key words: Dental implants, dental prosthesis, material resistance.

INTRODUCTION

The oral prosthetic rehabilitation using osteointegrated implants is becoming a daily clinic routine (Rosa et al., 2008; Cooper, 2009). An alternative for this treatment, being the provisional cantilever with distal extension is important (Zurdo et al., 2009). This prosthesis can provide comfort and facilitate adaptation for the patient. However, the masticatory forces are concentrated in these extensions. Often we can see fractures in the union between the cantilever and the last implant (Van Zyl, 1995).

The material choices for making temporary prosthesis is polymethylmethacrylate (PMMA), that presents favorable aesthetic property, easy handling and low cost. However, the mechanical properties of PMMA present low resistance under occlusal force (Berrong et al., 1990). Thus, several authors have proposed the inclusion of ribs in these polymers which are: nylon fibers (John et al., 2001), silica fibers (Vallittu et al., 1998), aluminum

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fibers (Grant and Greener, 2009), polyethylene fibers (Bae et al., 2001; Dixon and Breeding, 1992; Samadzadeh et al., 1997), steel wires (Carroll and von Fraunhofer, 1985; Hazelton et al., 1995; Powell et al., 1994), polyaramid fibers (Bae et al., 2001), carbon fibers (Ekstrand et al., 1987; Larson et al., 1991) and glass fibers (Vallittu, 1993; Keyf et al., 2003; Nohrström et al., 2000) in order to improve their properties, among them, the flexural strength and modulus of elasticity (Haselton et al., 2002). The purpose of these reinforcements is to improve its strength properties and flexural modulus.

According to Fonseca et al. (2011), among the types of observed reinforcements, the glass fiber treated with silane stood out by virtue of better incorporation of the fibers and the matrix, increased fracture resistance, easy handling and low cost. The development of resistant temporary prosthesis to be used in cantilever can bring greater functional and aesthetic comfort for edentulous patients.

This study aims to evaluate the fracture resistance of acrylic resins (PMMA) with the use of glass fibers treated with silane, depending on their distribution and positioning within the PMMA matrix used in temporary prosthesis with extension cantilevers.

MATERIALS AND METHODS

A stainless steel base I was used for the specimens and the other tests. Three sets of abutments (Neodent, Curitiba, Brazil) constitute a component of type titanium UCLA (4.1 mm diameter, 10.0 mm height) set on an analog of implant external hexagon platform (HE) titanium (same dimensions) with the same diameter Neotorque screw by means of lateral screws (Figure 1; 1).

A second metallic matrix II is constructed in two parts (upper and lower) to produce standardized samples simulating teeth 5, a canine, three pre-molars and molars, with interproximal areas of all teeth 5.0 ± 0.1 mm high and 5.5 ± 0.1 mm wide, with the area of cantilever of 21 mm. All dimensions were measured with a digital caliper (Figure 1; 2).

The preparation of specimens occurred positioning the bottom of the array II on the matrix I. A precision scale was used to weigh the portion of acrylic resin Dencrilay (Dencril, São Paulo, SP, Brazil). 3.8 g powder and 4.0 ml of monomer was used. The resin was mixed according to the manufacturer's specifications. When the resin reached the sandy phase, it was applied into the matrix II (Figure 1; 3). The upper part II to the matrix was coupled in the matrix I during the plastic phase of the resin and excesses were removed (Figure 1; 4). At that moment, an elastic was applied to about two matrices, and immediately taken to the orthodontic pan (VH Essence Dental Equipment, Araraquara, SP, Brazil) with water and under pressure of 20 psi for 10 min to complete the polymerization, facilitating subsequent polishing and avoiding the formation of bubbles inside, thereby eliminating this interference.

A single evaluator produced fifty specimens. The specimens were equally divided into 5 groups. The Group I was the control group. This group did not receive fiber reinforcement. In the other groups, samples were produced with glass fiber. All groups received 0.1 g of glass fibers (Maxi Rubber, Diadema, SP, Brazil). These fibers are treated with silane (Prosil, FGM, Joinville, SC, Brasil).

In Group II, the glass fibers were shredded and regrouped. These fibers were arranged in parallel bundles (Figures 2; 5). The specimens were produced in two stages. At first, the resin was inserted into the individual matrix in the sandy phase (Figure 2; 6). The glass fibers were treated with a silane and inserted into this matrix, making a previous strengthening infrastructure. This structure was taken to orthodontic pan. In the second step, these infrastructures were placed on the components for it to be located at the same level at the top of the pillars. Then, the specimens' preparation process continued being equal to the control group.

The specimens of Group III were constructed with a laminated glass fiber weft (Figure 2; 7). These fibers were positioned in the center of the specimens (Figure 2; 7.1). The glass fibers of the Group IV has been divided into two parts (Figure 2, 8). One of the parts was positioned at the level of the pillars. The other part was positioned in the upper portion of the matrix II (Figure 2, 8.1). In Group V, the specimens were produced with fibers arranged in two ways: encircling the three abutments and parallel to the occlusal surface. The beams which surrounded the implants were placed in the bottom of the matrix and measured 2 cm each, with a quantity of three filaments for each abutments (Figure 2; 9). The beam parallel to the occlusal surface was positioned on top of the matrix which contained ten glass fiber filaments with 3.5 cm in length (Figure 2; 9.1) (Table 1).

The specimens were evaluated for the presence of defects and bubbles, and were discarded when necessary. The specimens were polished and stored for 72 h in deionized water at 37°. The samples were tested in a universal testing machine (EMIC, São José dos Pinhais, PR, Brazil). An independent evaluator, conducted compression tests on the central groove of the molar. The end point of the tests was to fracture the specimen (Figure 3). Fracture strength of each specimen was recorded, and data were analyzed statistically by analysis of variance (ANOVA) and Tukey's test at 99%. Statistical analysis was performed using the statistical software BioEstat 5.3 (Mamirauá Civil Society/CNPq).

RESULTS

Table 2 shows the fracture resistance values for each specimen. The mean and standard deviation can also be observed in this table. ANOVA and Tukey test showed statistically significant difference among groups. Groups III, IV and V were significantly more resistant to fracture as compared to Groups I and II. Assessing the means obtained by groups, it is observed that Group IV was the best. The other groups (Groups V, III, II and I respectively) showed lower performance. Comparing the group with each other, this study observe a statistically significant difference between Groups I and III (4.076); I and IV (5.826); I and V (4.484); II and III (3.188); II and IV (4.939); II and V (3.596). However, there were no statistically significant difference between Groups I and II (0.888); III and IV (1.75); III and V (0.408), IV and V (1.342), respectively.

DISCUSSION

A composite material is formed by a combination of two or more materials. These materials differ in form and chemical composition being insoluble in each other. In the case of polymer matrix composites (PMC), materials are a polymer resin matrix and glass fibers (Smith, 2008; Callister, 2007; Narva et al., 2004).

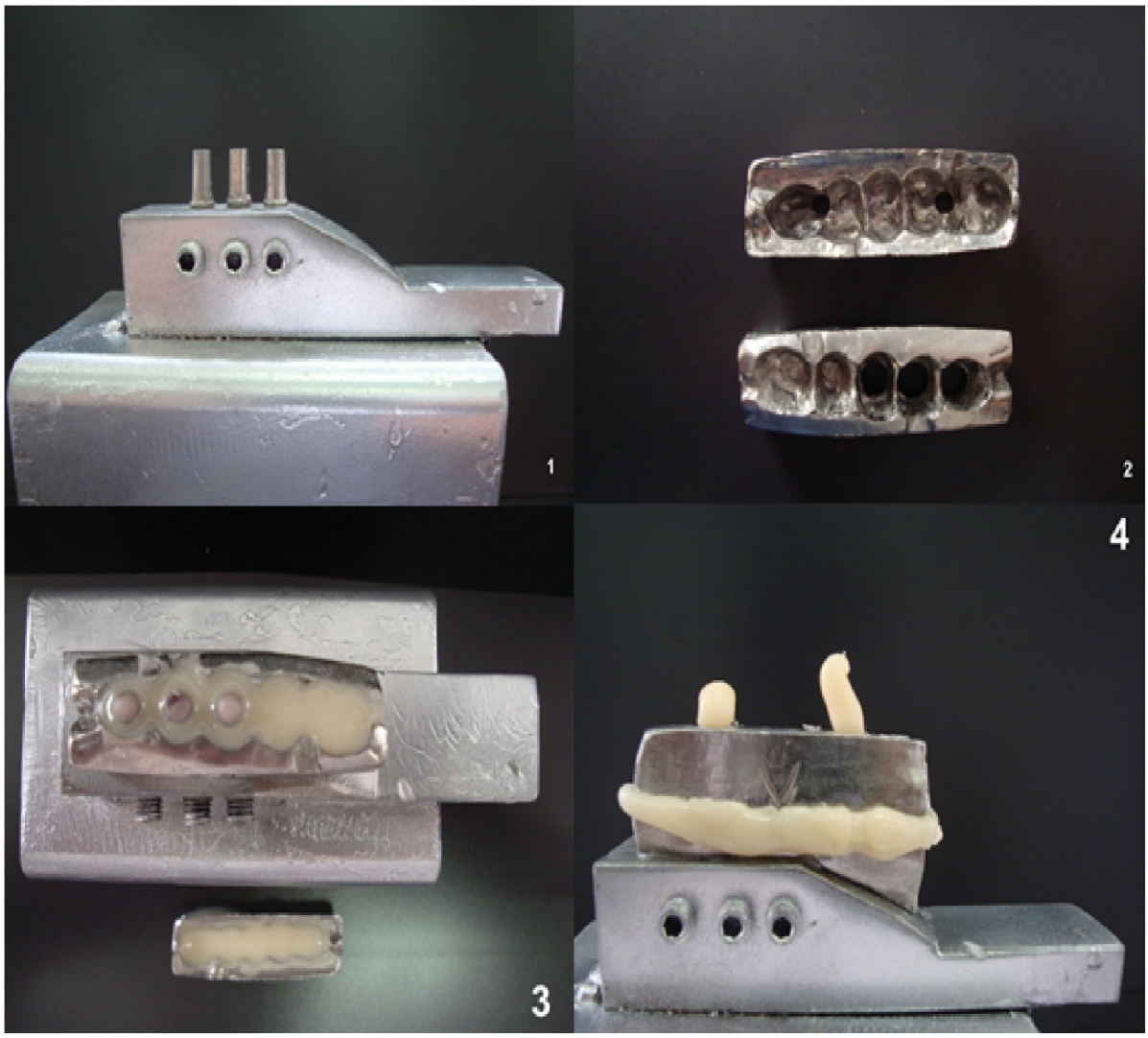

Figure 1. 1. Metallic mould I used as support for the production of specimens and tests in universal testing machine (EMIC); 2. Metallic mould II, top and bottom, used for production of standard specimens; 3. Acrylic resin Inclusion in the upper and lower portion of the metallic mould II in position on the metallic mould I; 4. Top positioned on the bottom of the metallic mould II when reaching the plastic phase.

The resistance of the composites is influenced significantly by factors such as arrangement, orientation and distribution of fibers. Composites with uniform distribution of the fibers should have better properties (Callister, 2007; Colán et al., 2008; Uzun et al., 1999; Hazelton er al., 1995). Another factor is expected that the use of the silane promotes an effective bond between the fiber and resin (Ekstrand et al., 1987; Vallittu, 1993). The results of this study showed that Group III (single laminated glass fibers), IV (double laminated glass fibers) and V (glass fibers surrounding the implant and parallel to the occlusal surface) significantly increased fracture toughness when compared with the Groups I (control group) and II (aligned glass fibers).

Group II (aligned glass fibers) was constructed with the addition of glass fibers. However, the specimens showed no resistance to fracture which was significantly higher, than that in the control group. This finding can be explained by the manufacturing process in two steps of these specimens. In this group, the fibers were applied to the element constructed in different time and after separate manufacture, these reinforcements were added to specimens, assuming a central position within the resin matrix. This device does not seem to interact with the provisional acrylic resin. The fiber reinforcement behaves independently with the acrylic matrix. So, the interim did not benefit from the addition of fiberglass. A union between these two similar materials built and polymerized at different times does not form a composite. Some manufacturers provide glass fibers impregnated

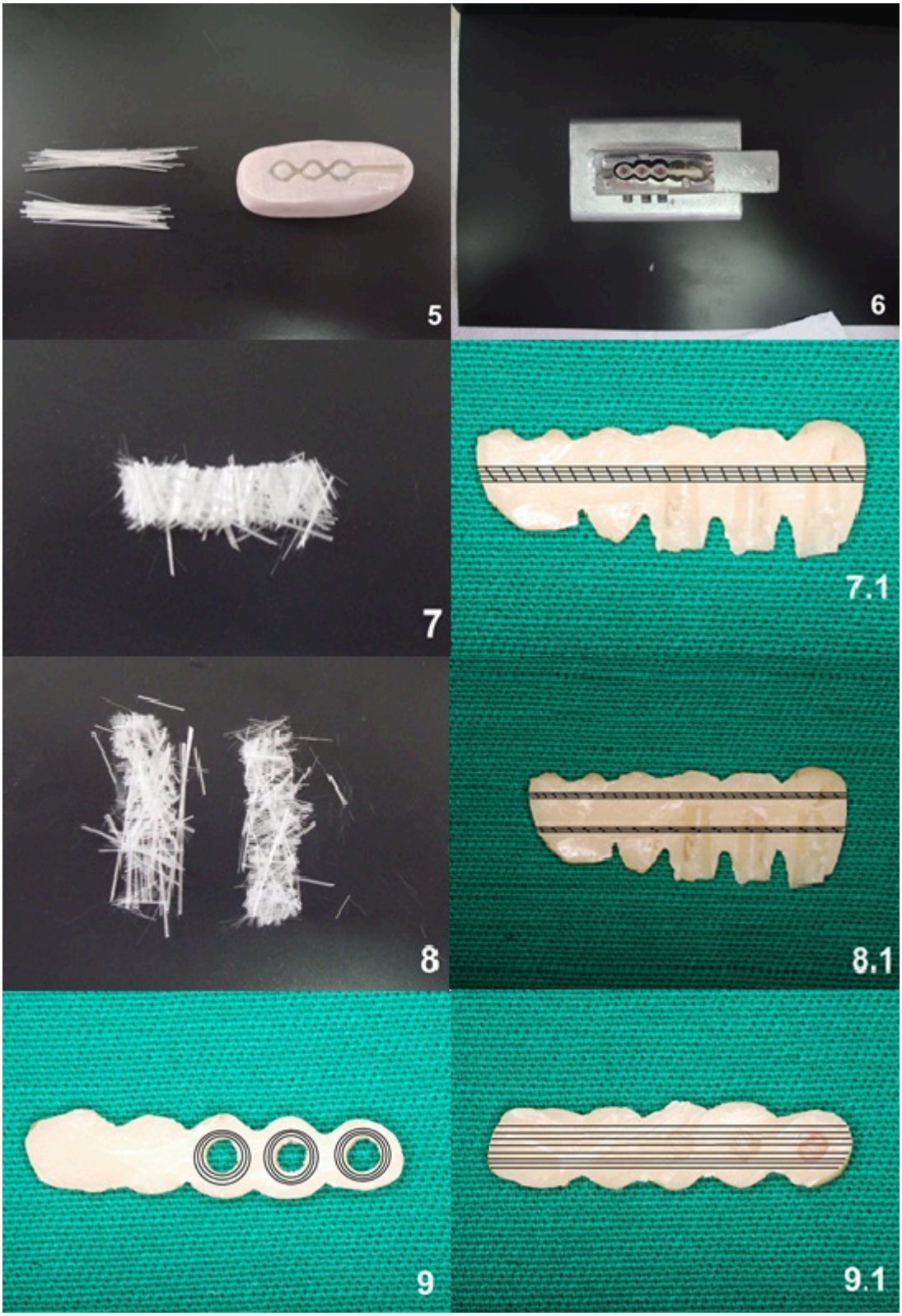

Figure 2. 5. Individual matrix for production of reinforcements for the Group II; 6. Strengtheningproduced in the individual matrix within the matrix II; 7. Glass fiber strips treated with silane; 7.1. Group III illustrates the position of the simple laminated glass fibers within the provisional prosthesis in the sagittal section; 8. Glass fiber strips treated with silane and separated into two parts; 8.1. Double laminated acrylic resin within the matrix of the Group IV (sagittal); 9. Arrangement of glass fibers surrounding the pillars in Group V in a cross section in the provisional prosthesis; 9.1. Continuous fibers and parallel to the occlusal surface.

Table 1. Composition groups.

Group	Composition
I	Control group, without reinforcement
II	Reinforced with continuous, concentrated and aligned fibers
III	Enhanced with simple fiber laminate
IV	Doubly reinforced fiber laminate
V	Reinforced with fibers surrounding the implants and parallel to the occlusal surface.

Table 2. Fracture resistance values (kgf) per specimen (sp) of each study group, with respective mean (m) and standard deviation (SD).

sp	Group I	Group II	Group III	Group IV	Group V
1	6.39	12.79	12.4	13.9	15.05
2	7.61	8.06	9.24	14.0	12.75
3	7.78	8.83	14.94	18.14	14.07
4	6.5	10.25	13.41	13.45	12.79
5	9.03	7.02	14.94	9.83	12.23
6	7.71	7.37	12.3	17.27	11.19
7	9.8	9.9	11.67	14.98	13.13
8	8.41	7.92	12.13	16.3	12.79
9	11.08	11.95	11.12	11.4	15.36
10	10.91	10.01	13.83	14.21	10.7
m	8.52	9.41	12.6	14.35	13.01
dp	[1.66]	[1.93]	[1.76]	[2.52]	[1.49]

Figure 3. Moment of specimen fracture when tested in the universal testing machine.

with resin composite.

Groups III (single laminated glass fibers) and IV (double laminated glass fibers) made use of laminated fibers, interwoven and oriented in strategic positions over the specimens. The fibers were similar in weight and interlacing. However, they were distributed at different positions in the acrylic resin matrix. The oriented positioning is beneficial because it is stable and reduces flexing of the specimen. However, there was no statistically significant difference between these two groups despite heterogeneity of distribution of the fibers position. Possibly, this happened because the vertical length of the specimens does not have enough greatness to be influenced by the fiber positioning. In addition, the reduced size of the samples probably also helped that there was no significant divergence.

Glass fibers (Group V) were separated by removing the interlacing. With this change, it was possible to arrange the fibers in parallel. Thus, the fibers were distributed with greater uniformity in the positioning. In this group, the fibers also was arranged to involve the implants at the level of the pillar. Thus, it was possible to increase the resistance in this region. The results of fracture toughness of these specimens were higher than those of Groups I and II. These results came from the fact that all reinforced species has the same amount of fibers. Once groups were positioned in two different ways between them, they seem to be acted with individual entity and so with the half of quality of the fibers of the other groups. However, there was no statistically significant difference when compared with Groups III and IV. These results seem to indicate that the disposition of the fibers is less important than the weight used. This study did not aim to evaluate the variation of the weight of glass fibers.

The results obtained from the Group III (single laminated glass fibers), IV (double laminated glass fibers) and V (glass fibers surrounding the implant and parallel to the occlusal surface) are similar to those reported by John et al. (2001), Keyf et al. (2003), Kim and Watts (2004), Vallittu (1993, 1998), Vallittu and Lassila (1992), Vallittu et al. (1994), and Narva et al. (2004) who found a significant increase of the flexural strength of specimens PMMA resin reinforced by glass fibers compared to non-reinforced specimens. New research should to be developed with the aim of greater fracture resistance and the assessment of this prosthesis in testing fatigue and thermal cycling.

Conclusion

According to the methodology used and the results obtained in this study, it could be concluded that the provisional prosthesis with an extension cantilever is reinforced with glass fibers, which can be a viable alternative to oral rehabilitation treatment because Group III (single laminated glass fibers), IV (double laminated glass fibers) and V (glass fibers surrounding the implant and parallel to the occlusal surface) increased significantly with the fracture resistance compared with provisional built without reinforcement.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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Full Length Research Paper

Lidocaine subgingival irrigation modulates the levels of prostaglandin E_2 levels in gingival crevicular fluid after periodontal therapy

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The aim of this study was to evaluate if lidocaine 2% with 1:100.000 epinephrine, used as subgingival irrigation, has anti-inflammatory effect after periodontal therapy. Seventeen patients were selected to this paired split mouth randomized, subject-blind study. Each patient had a minimum of two sites labeled and alleatory separated, both with probe depth ≥ 5 mm. Each site were separated in two groups: scaling and root planing + lidocaine 2% with 1:100.000 epinephrine used as subgingival irrigation (LD); and scaling and root planing + saline solution (SRP), both groups were blinded to the examiner. Clinical periodontal parameters were recorded: plaque index (PI), bleeding on probe (BOP), probing depth (PD), gingival recession (GR) and clinical attachment level (CAL). Levels of GCF-PGE_2 were analyzed by enzyme-linked immunosorbent. All parameters were recorded at baseline (1 and 3 months) after periodontal treatment. The results indicated reduction of PI, BOP, PD, CAL for LD and SRP groups and GCF-PGE_2 levels were reduced in LD group after 3 months periodontal therapy. The LD and SRP groups were equally efficacious to control the periodontal disease after 3 months. However, LD improved the reduction of PGE_2 levels and maintains the inhibitory anti-inflammatory effect on PGE_2 after 3 months of periodontal treatment.

Key words: Lidocaine, periodontal treatment, prostaglandin E2.

INTRODUCTION

Lidocaine is local anesthetics of amino amide type and it has been used in dental practice to block peripheral nerves and to prevent pain in dental procedures (McLure and Rubins, 2005). Epinephrine is a vasoconstrictor used

as adjunct of lidocaine, which promotes arterial; reducing bleeding and also delays the resorption of lidocaine, almost doubling the duration of anesthesia (Cepeda et al., 2010). Lidocaine has limited allergenicity and rare incidence of hypersensitivity reactions. It is formulated in cartridges as 2% lidocaine with 1:50.000, 1:100.000 and 1:200.000 epinephrine. The 2% lidocaine with 1:100.000 epinephrine is considered the standard for comparison with newer anesthetics. Lidocaine with epinephrine rapidly induces oral anesthesia and provides surgical anesthesia that last 90 to 180 min (Hawkins and Moore, 2002).

However, local anesthetic has not only effect on pain control, but it can also promote anti-inflammatory and antibiotic systemic effects. Local anesthetics have shown to be potent inhibitors of inflammation, reduce edema formation in various conditions (Winning et al., 2012; Garutti et al., 2014). The anti-inflammatory effect of local anesthetics has not been totally elucidated, but it should possess a wide range of anti-inflammatory actions through their effects on cells of the immune system, as well as microorganisms, thrombocytes leukocytes and erythrocytes (Ohsaka et al., 1994; Cassuto and Tarnow 2003; Lan et al., 2005). Garutti et al. (2014) confirm the anti-inflammatory effect of lidocaine. The authors reported that the expression tumor necrosis factor α (TNF-α) decreased after systemic administration.

Periodontal disease is a group of inflammatory disease that started with periodontal pathogenic biofilm that destroyed supporting tissues: Cement, periodontal ligament and caused bone loss (Offenbacher, 1996). In addition, pro-inflammatory cytokine mediate host defense and are frequently present in higher levels in periodontal tissues. Chemokines are cytokines that play an important role in leukocyte recruitment and may directly or indirectly modulate osteoclast formation.

Prostaglandin E_2 (PGE_2) is one of pro-inflammatory products that can mediate tissue destruction in periodontal disease (Offenbacher, 1996). It is present in high levels at sites with inflammation and pain (Funk, 2001). It has been associated with changes in fibroblast metabolism and bone resorption (Offenbacher and Heasman, 1993). In addition, PGE_2 levels have been noted to be elevated in the gingival crevicular fluid (GCF) from patients with gingivitis and chronic periodontitis (Salvi and Lang, 2005).

After periodontal treatment, the levels of PGE_2 should be decreased due to re-establishment of healthy periodontal (Sánchez et al., 2013). For several years, studies have been made to improve the outcomes of scaling and root planing using laser application, antibiotic systems, irrigation solutions, chlorhexidine digluconate, povidone-iodine, sodium chloride, etc (Krück et al., 2011). However, there are few reports about the effects of the local anesthetic in inflammatory process after periodontal treatment. Derman et al. (2014) used anesthesia gel to treat periodontal pockets and found benefits, less pain and discomfort during procedures and similar attachment gain comparing local anesthetic gel and injection. Based on this report, this study intends to test whether lidocaine 2% with 1:100.000 epinephrine used as subgingival irrigation as adjunct to scaling and root planing can promote greater attachment gain and reduction of the levels of PGE_2 of gingival crevicular fluid compared with control group after 3 months of periodontal therapy.

MATERIALS AND METHODS

Seventeen patients (mean aged 38.5 ± 8 years old), both genders (48% male) were selected to this paired split mouth randomized, subject/examiner-blind study. All subjects were recruited from the Department of Periodontology, School of Dentistry, Fluminense Federal University, Nova Friburgo, Rio de Janeiro State, Brazil, over a period of 6 months between 2011 and 2012. The study protocol was approved (protocol number: CAAE-0157.0.258.000-10) by the ethics committee of the Medicine School, Fluminense Federal University. Prior to participation, the purpose and procedures were fully explained to all patients, who consequently gave written informed consent in accordance with the Helsinki Declaration. Medical and dental histories were taken and patients received clinical evaluation at prescreening visits. Inclusion criteria were: presence of periodontal disease in unirradicular teeth, bleeding on probing in sites where probing depth was ≥ 5 mm in a minimum of two teeth in different arch; and radiographic bone loss ranging from 30 to 50%. Exclusion criteria were: patients with systemic diseases; diabetes; osteoporosis; pregnant lactating females; use of immune suppressive medication, phenytoin, cyclosporine, calcium channel blockers or any use of antibiotics or nonsteroidal anti-inflammatory drugs in the past 3 months; and any medical conditions requiring immunotherapy or diagnosed as HIV + or with AIDS, that could interfere with the periodontum.

An experienced periodontist evaluated the clinical parameters and selected two unirradicular teeth for the protocol procedure. Each selected tooth were measured by periodontal parameters: Plaque index (PI), bleeding on probe (BOP), probing depth (PD), gingival recession (GR), clinical attachment level (CAL) using a periodontal probe PCP15 (PCP- UNC15, Hu-Friedy, Chicago, IL), six sites (mesio-buccal, mediobuccal, disto-buccal, mesio-lingual, medio-lingual, disto-lingual) were recorded. One site with PD ≥ 5 mm was selected and labeled in sites number 1 or 2 to receive subgingival irrigation labeled in 1 or 2.

Gingival crevicular fluid (GCF) was sampled 1 week after clinical examination, by a blinded researcher to clinical parameters, in order not to alter the nature of the GCF. GCF samples were taken from two different sites labeled as 1 or 2, both sites with the deepest PD was ≥ 5 mm and BOP were chosen for sampling the same patient. After removal of the supragingival biofilm with sterile cotton pellets, the sites were isolated with sterile cotton rolls and dried with an air syringe to eliminate the possibility of contamination with saliva. GCF was collected by inserting microcapillary 5 µl approximately 2 mm into the sulcus. GCF visually contaminated

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with blood was discarded. The GCF was immediately placed into separate microcentrifuge tubes containing 250 µl phosphate-buffered saline. The samples were stored at -20°C for subsequent assays. The samples were analyzed by a single-blinded examiner using a commercial PGE_2 specific enzyme-linked immunosorbent assay (R&D Systems, Minneapolis, MN, USA).

After clinical parameters were recorded, periodontal treatment was performed using Gracey curets to scaling and root planing associated with 50 µl of blinded solution labeled as 1 or 2. After periodontal treatment, each patient received subgingival irrigation once a week until one complete month and received oral hygiene instructions. GCF samples, clinical parameters measurements and periodontal treatment were recorded at baseline, 1 and 3 months. After the study had finished, the solutions were revealed by a blinded pharmacologist to this study: number 1 was identified as LD (Lidocaine group, containing lidocaine 2% with 1:100.000 epinephrine (Alphacaine 100®, DFL-Brazil) and number 2 was identified as scaling and root planing + saline solution (SRP; placebo group, containing saline solution).

Statistical analysis

Required sample size was determined by G*Power (G*Power, Franz Faul, Kiel University, Germany, Version 3.1.2, 2009) and was calculated to detect a 0.5 difference between BOP, LD and SRP groups at the 0.05 probability level with a power of 92%. The power calculation analysis revealed that the required sample size was a minimum of 17 subjects for each study group. The primary efficacy variables were whole-mouth mean BOP LD and SRP groups. Statistical analysis was performed on data obtained from all patients who completed the trial.

The decision about whether to use parametric or non-parametric tests was made based on the results of Shapiro-Wilk Normality Test for normal distribution.

Statistical tests were performed using the Statistix software (Analytical Software, Tallahassee, FL, USA, Version 8.0, 2003). A Repeated Measures - ANOVA was performed to compare clinical parameters (PI, BOP, PD, GR, CAL and GCF) among LD and SRP groups. All variables were normally distributed, except GCF-PGE_2. The Mann Whitney test was used to analyze differences in GCF-PGE_2 levels among LD and SRP groups and among baseline, 1 and 3 months. Statistical significance for all variables was defined as $p \leq 0.05$.

RESULTS

The mean ± standard deviation (± SD) of LD and SRP groups after periodontal treatment are presented in Table 1. Both groups had similar means of clinical parameters, no statistically significant differences of mean were found to PD and CAL between LD and SRP groups. Percentage of PI and BOP were also similar between the groups. No differences were found to GR and CGF parameters during baseline, 1 and 3 months. Comparison between times, baseline and 1 month and baseline and 3 months were also tested (Repeated Measures - ANOVA). All clinical parameters reduced after 1 and 3 months. This result shows that both therapies were efficient for periodontal disease control.

The GCF-PGE_2 levels were compared between LD and SRP groups and treatment intervals (baseline × 1 month and baseline × 3 months) after periodontal treatment. No differences were found between LD and SRP groups. Although, LD group had statistically significantly reduction at 1 month and 3 months to GCF-PGE_2 levels (Mann Whitney Test, $p \leq 0.05$). No difference was found to SRP group when compared 1 month and 3 months to GCF-PGE_2 levels. Lidocaine delivery shows to interfere with GCF-PGE_2 levels probably due to anti-inflammatory effects; however it did not improve clinical results (Figure 1).

DISCUSSION

This study evaluates the effect of lidocaine subgingival irrigation as adjunct of scaling and root planing in modulate PGE_2 responses after periodontal therapy. This study reveals that LD group had similar result to the clinical parameter to SRP group after 3 months periodontal therapy. Indeed, LD group revealed significant improvement to control PGE_2 levels compared to control group, 1 month and 3 months after periodontal treatment, suggesting that lidocaine subgingival irrigation can modulate inhibitory effect on inflammatory process. Recently, studies have correlated the high levels of PGE_2 in sites with periodontal disease and suggested that PGE_2 can mediate tissue destruction during periodontal disease (Chen et al., 2013; Sánchez et al., 2013). Kumar et al. (2013) reported that chronic periodontitis subjects treated by non-surgical periodontal therapy-SRP have mean PGE_2 concentrations in GCF and statistically it reduced significantly after periodontal therapy.

These results are in accordance with the results of this study that found reduced levels of PGE_2 after 1 and 3 months of periodontal therapy for both groups. According to Kumar et al. (2013), these results are associated with and are responsible for at least in part, inflammatory changes in the affected tissues. Levels of GCF PGE_2 can be used as a marker of gingival inflammation in order to determine the effect of periodontal therapy. The authors explain that most inflammation and periodontal destructive changes that occur in PD such as gingival redness, edema, collagen degradation and bone loss could be caused solely by the presence and direct actions of PGE_2. PGE2 can induce vasodilatation and increased capillary permeability, which elicit clinical signs of redness and edema. The vasoactive effects of PGE_2 are also enhanced by synergistic interactions with other inflammatory mediators such as bradykinin, cleavage fragments of the complement cascade and histamine (Salvi and Lang, 2005). PGE_2 can induce bone resorption and increase the number of osteoclasts, elevate Adenosine-3, 5-monophosphate (cAMP) levels of osteoblasts and osteoclasts (Dziak, 1993). The osteoclastic bone resorption is regulated through the stimulation of osteoclasts by PGE_2 (Chambers and Dunn, 1983). There is overwhelming body of evidence, which correlates with PGE_2 levels within the periodontal tissues

Table 1. Means, standard deviations and comparisons of LD (lidocaine delivery) and SRP groups at baseline, 1 month and 3 months after periodontal therapy.

	LD (n = 17)	SRP (n = 17)
PI		
Baseline	46.06 ± 48.43	28.6 ± 43.08
1 month	29.40 + 12.12	11.76 + 33.21†
3 months	26.47 ± 43.72	8.82 ± 26.43‡
BOP		
Baseline	98.00 ± 8.24	95.05 ± 14.23
1 month	49.00 + 4.49	62.70 + 41.46†
3 months	56.82 ± 41.29	69.58 ± 36.45‡
PD (mm)		
Baseline	5.05 ± 0.24	5.47 ± 0.51
1 month	3.17 + 0.63	3.35 + 0.82†
3 months	3.11 ± 0.69	3.05 ± 0.55‡
GR (mm)		
Baseline	0.64 ± 1.53	0.39 ± 0.68
1 month	0.70 + 1.82	0.35 + 0.86
3 months	0.88 ± 2.31	0.58 ± 1.32
CAL (mm)		
Baseline	5.70 ± 1.53	5.52 ± 0.62
1 month	3.88 + 1.96	3.76 + 1.74†
3 months	3.76 ± 1.82	3.81 ± 1.51‡
GCF (μl)		
Baseline	0.40 ± 0.12	0.39 ± 0.11
1 month	0.39 ± 0.14	0.38 ± 0.12
3 months	0.37 ± 0.16	0.36 ± 0.12

*P values represent statistically significant differences between LD and SRP (Repeated Measures - ANOVA) $p \leq 0.05$; †P values represent statistically significant differences between baseline and 1 month (Repeated Measures - ANOVA) $p \leq 0.05$; ‡P values represent statistically significant differences between baseline and 3 months (Repeated Measures - ANOVA) $p \leq 0.05$.

and within the crevicular fluid to the clinical expression of PD (Offenbacher and Heasman, 1993). Lidocaine 2% with 1:100.000 epinephine was selected to this study because it is easy to be purchased, inexpensive and commonly found in dental offices. It is a local anesthetic, well documented, that causes a nerve blocking effect, acting in pain prevention during dental procedures (Cassuto et al., 2006). Actually, it is also known to possess anti-inflammatory actions through their effects on cells of the immune system. The potent anti-inflammatory properties of local anesthetics, superior in several aspects to traditional anti-inflammatory agents of the NSAID and steroid groups and with fewer side-effects, has prompted clinicians to introduce them in the treatment of various inflammation-related conditions and diseases. They have proved to be successful in the treatment of burn injuries, interstitial cystitis, ulcerative proctitis, arthritis and herpes simplex infections. The detailed mechanisms of action are not fully understood but it seems to involve a reversible interaction with membrane proteins and lipids thus regulating cell metabolic activity, migration, exocytosis and phagocytosis (Cassuto et al., 2006).

Over the years, many chemical agents have been used as adjunct to SRP to improve the outcome; these substances are commercially available in the form of gel, strips and chips. These materials in high concentration, have improved the clinical results (Greenstein and Polson,

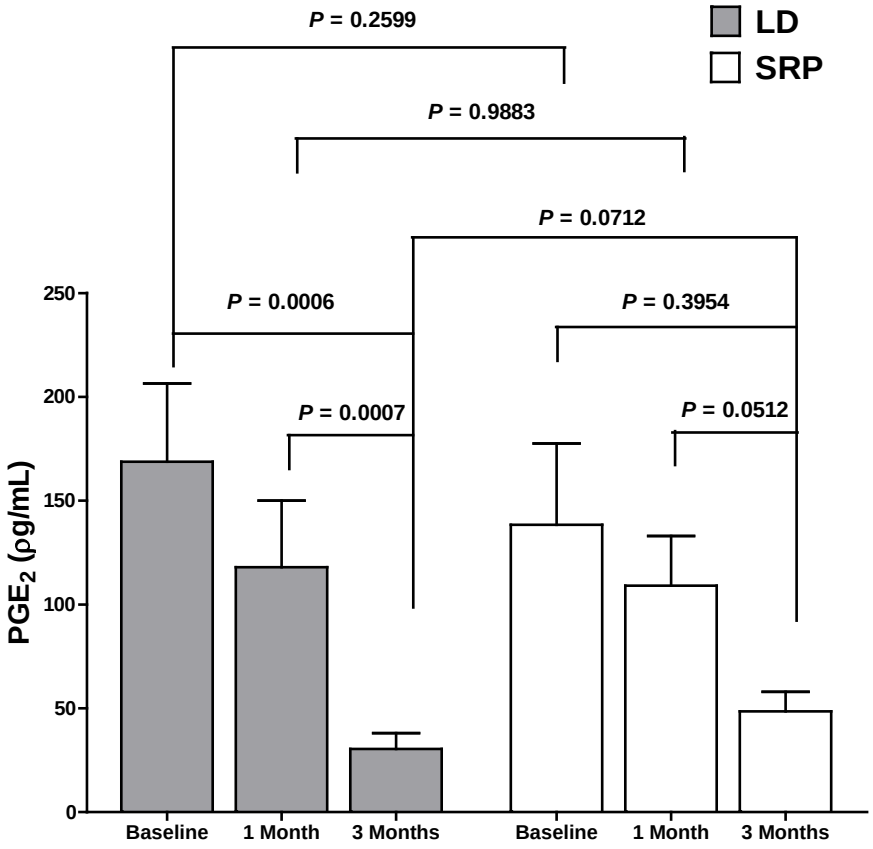

Figure 1. Modulation of GCF-PGE_2 levels of LD and SRP groups. Statistically significant difference between baseline and 1 month and baseline and 3 months after periodontal treatment to LD group and 1 month and 3 months to SRP group ($P \leq 0.05$ Mann Whitney Test). No Statistically significant differences to GCF-PGE_2 levels were detected to baseline, 1 month and 3 months between LD and SRP groups ($P > 0.05$ Mann Whitney Test).

Polson, 1998). However, irrigation solutions, such as chlorhexidine digluconate, povidone-iodine and sodium chloride, without SRP, have failure to demonstrate better results than SRP alone, but they were satisfactory to control periodontal disease when it is associated to SRP (Krück et al., 2011). These findings were in accordance with this study that used SRP as adjunct to lidocaine and saline solutions. Both groups, LD and SRP, were efficient to the control of periodontal disease after 3 months periodontal therapy. Table 1 shows reduction of CAL means 5.70 to 3.76 mm to LD group and 5.52 to 3.81 mm to SRP group after 3 months intragroup analysis. Although between groups LD and SRP groups, no difference were found. These local anti-inflammatory effects of lidocaine 2% with 1:100.000 epinephine were in agreement with Derman et al. (2014) that compare gel and injection lidocaine in periodontal pocket.

Other studies have been using lidocaine as adjunct of scaling and root planing to reduce a painful procedure (Svesson et al., 1994; Friskopp et al., 2001; Pandit et al., 2010). These authors suggested that gel is highly acceptable and can easily be administered into the periodontal pocket. Their results also show that gel does not interfere with the SRP procedure and no clinical signs of mucous membrane irritation were recorded, taste also does not affect the patients' willingness to have the gel at their next visit. So this study suggested that new researches should be made to investigate the anti-inflammatory effect of lidocaine gel in longitudinal evaluation of SRP.

Early studies have shown that inhibitory effects on PGE_2 have been reported after anesthetics administration (Cassuto et al., 1995, Jönsson et al., 1999; Cassuto and Tarnow, 2003). Lidocaine administration significantly secret IL-8 and IL-10 in cell culture experiments and this effect can mediate inhibition of NFkb via decrease IkB phosphorylation (Lang et al., 2009). In a recent study a potent inhibition of PGE_1 and PGE_2 release was

demonstrated when treating the burned skin in the intact animal with a topical local anesthetic cream (Yregård et al., 2001), thus confirming an earlier report showing reduced PGE_2 release from isolated pieces of gastric mucosa by lidocaine (Goel et al., 1994). These inhibitory effects on PGE_2, known to play a significant role in the mechanisms responsible for inflammatory pain, could account for some of the potent analgesic effects of intravenous lidocaine reported in burn patients (Jönsson et al., 1999, Cassuto and Tarnow, 2003) and in patients having undergone surgery (Cassuto et al., 1995; Chen et al., 2013).

This study did not test the effect of lidocaine in pain after periodontal treatment but suggested new approach to use lidocaine subgingival irrigation, as adjunct of periodontal treatment based on LD can reduce PGE level (Jönsson et al., 1991; Cassuto et al., 1995; Cassuto and Tarnow, 2003). PGE_2 is present in tissue destruction with periodontal disease (Offenbacher, 1996). This study suggested that LD group improved statically significant reduction of GCF-PGE_2 levels at 1 month and 3 months after periodontal therapy and confirm that after administration, lidocaine can reduce the level of PGE_2 and it was able to maintain these results during the 3 months.

Within limits of this study, the lidocaine irrigation substance used as adjunct of SRP was efficacious to control periodontal disease and reduces GCF-PGE_2 levels after 3 months of periodontal therapy. However, further research should be improved to confirm LD dosage or tested biochemical potential to suggest new approach to lidocaine to improve clinical periodontal parameters and contribute to reduce tissue destruction. This study also suggested that new research should be done to test the anti-inflammatory efficacy of lidocaine used as adjunct of SRP after periodontal treatment and verify if these outcomes should be maintained over the times.

Conclusion

Based on these findings, the LD and SRP groups were equally efficacious to control the periodontal disease after 3 months. LD group improved the reduction of GCF-PGE_2 levels at baseline and 1 month and 3 months after periodontal treatment, suggesting that the lidocaine 2% with 1:100.000 epinephrine can maintain inhibitory effect of PGE_2 after administration and it suggested that it can contribute to improve the reduction of this biochemical parameters connected to tissue destruction.

Conflicts of interest

The authors declare that they have no conflict of interest.

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