

ORIGINAL ARTICLE, DENTAL MEDICINE

Influence of Er:YAG Laser on Objective and Subjective Parameters of Stress during Sealant Application in Children

Maria P. Shindova¹, Ani B. Belcheva¹, Nonka G. Mateva²

¹ Department of Pediatric Dentistry, Faculty of Dental Medicine, Medical University of Plovdiv

² Department of Medical Informatics, Biostatistics, E-learning, Faculty of Public Health, Medical University of Plovdiv

Correspondence:

Maria P. Shindova, Department of Pediatric Dentistry, Faculty of Dental Medicine, Medical University of Plovdiv, 3 Hristo Botev Blvd., 4000 Plovdiv, Bulgaria
E-mail: mariya.shindova@gmail.com
Tel: +359 898 390 935

Received: 23 Feb 2016

Accepted: 15 Aug 2017

Published Online: 25 Sept 2017

Published: 30 June 2018

Key words: anxiety, assessment methods, sealant, prevention, children

Citation: Shindova MP, Belcheva AB, Mateva NG. Influence of Er:YAG laser on objective and subjective parameters of stress during sealant application in children. *Folia Med* (Plovdiv) 2018;60(2):275-82.

doi: 10.1515/folmed-2017-0086

Background: Acceptance of lasers as alternatives and accessory tools to traditional methods in dental medicine has created an explosion of interest. Er:YAG laser is recommended for enamel conditioning. There is no study evaluating the anxiety in children during fissure sealing procedures when using Er:YAG laser compared to the routine application technique.

Aim: To evaluate the objective and subjective stress parameters in children during a preventive procedure when using Er:YAG laser for additional enamel conditioning before pit and fissure sealant application compared to the routine clinical application technique.

Materials and methods: The study included sixty-four 6-12-year-old children, divided into two equal treatment groups. A standardized fissure sealant application was performed, as in the intervention group before acid etching, the occlusal surfaces of teeth were conditioned with Er:YAG laser (2940 nm). During the procedure, objective and subjective stress parameters were recorded.

Results: Significantly lower degree of dental anxiety was found at the end of the dental visit of the study group ($p < 0.001$). During the professional cleaning of the tooth surface, the mean heart rate was low (95.55 ± 14.29 bpm) within the physiological normal range. The objective and subjective stress parameters show no significant differences between the two subgroups during sealing procedure ($p > 0.05$).

Conclusions: Application of Er:YAG laser during sealant application does not provoke anxiety and is well accepted by children in dental environment. Preventive procedures at the beginning of a dental visit decrease the initial levels of dental anxiety and contribute to an effective treatment process.

BACKGROUND

Dental anxiety can be defined as the feeling of apprehension about dental treatment which is not necessarily connected to a specific external stimulus.¹ Four types of assessing scales to measure dental fear in children are used: psychometric scales, projective techniques, behavior evaluation and physiological measures.² In using a self-report measurement technique, only the cognitive component of the dental anxiety construct is covered.³ Thus, a more complete evaluation of dental anxiety is recommended. Some authors use dentists' independent ratings of the patients' anxiety during treatment in addition to the self-report instruments.⁴ Other researchers rely on the objective stress parameters that can be obtained by measuring pulse rate, breath rate, skin resistance, blood pressure.⁵

Pit and fissure sealants (sealants) are one of the most widely used non-operative preventive methods in dental health care. They have been recommended for caries prevention along with good oral hygiene, optimal fluoridation, and healthy dietary habits.^{6,7} To be effective in the prevention of pit and fissure caries, a sealant must truly 'seal', i.e. it must completely keep out fermentable food substrates.⁷ For this reason there are many studies that investigate the proper performance of the clinical technique for sealant restorations and the effect of acid etching on the microleakage.⁶⁻¹¹

Many studies have reported the effect of Er:YAG laser for enamel conditioning.¹²⁻¹⁶ The acceptance of lasers as variable alternatives and accessory tools to traditional methods in dental medicine is an event that has created an explosion of inter-

est.¹⁷ There is no study evaluating the subjective and objective stress parameters in children during preventive procedures when using Er:YAG laser compared to the routine techniques.

AIM

The aim of this study was to evaluate the objective and subjective stress parameters in children during a preventive procedure using Er:YAG laser for additional enamel conditioning before pit and fissure sealant application compared to the routine clinical application technique.

MATERIALS AND METHODS

Sixty-four patients, who met the inclusion criteria and did not meet the exclusion ones, took part in the study and were randomly divided into two equal treatment groups.

The inclusion criteria were:

- children aged 6-12 years;
- presence of one or more permanent molars with indications for pit and fissure sealing;
- no previous experience with laser treatment prior the present study;
- signed informed consent form from the parents;

The exclusion criteria were:

- children with systemic diseases and mental disorders;
- incompletely erupted tooth to seal;
- use of medications that have effect on the cardiovascular system's functions;
- current diseases (cold, fever, etc.)
- allergy to the materials and medications used in the procedure;

The study was approved (No. P-1371/29.05.2015) by the Ethics Committee of the University Clinic where the research took place.

Before sealing, each tooth was cleaned with pumice paste (CleanPolish, Kerr) for 30 seconds. After rinsing with water spray it was dried with air spray. A clinical evaluation of the fissures followed and only intact teeth with no decay on the occlusal surface were included in the study. Cotton rolls were positioned on the buccal and/or lingual region of the tooth to be etched. Additionally, a saliva ejector was placed. The teeth were etched using 35% phosphoric acid gel (Etching gel, DMP Ltd) for 30 seconds and rinsed for the same time. In the first (laser) group before acid etching the occlusal surfaces of teeth were conditioned with Er:YAG laser (2940 nm) (LiteTouch, Syneron Medical Ltd.). For laser conditioning, the following parameters and operative mode were used: tip-to-tissue distance: non-contact mode (1.5 mm); tip diameter 600 µm; laser energy 70 mJ; pulse frequency 10 Hz; water spray level 8; average power 0.7 W; energy density 67 J/cm². In the control group the routine clinical application technique was used. The fissure sealant (Pit&Fisssure Sealant, DMP Ltd) was applied and spread out with a ballpoint applicator. The sealant was light-cured for 20 seconds. Finally, the occlusal contacts were checked with an articulating paper (**Fig. 1**).

The patient's subjective anxiety was recorded two times – before and after the dental visit, using modified version of the self-report Faces Scale by LeBaron (**Fig. 2**).^{18,19} It comprises a row of five faces ranging from 'relaxed' to 'very worried' in combination with a visual analogue scale of 0–10. Each child was asked to point to the face or choose the number which most closely depicted its state of anxiety. The patients were divided into four groups:

- Group I – no dental anxiety – 0÷2.9;
- Group II – low level of anxiety – 3÷4.9;
- Group III – medium level of anxiety – 5÷6.9;
- Group IV – high level of anxiety – 7÷10.

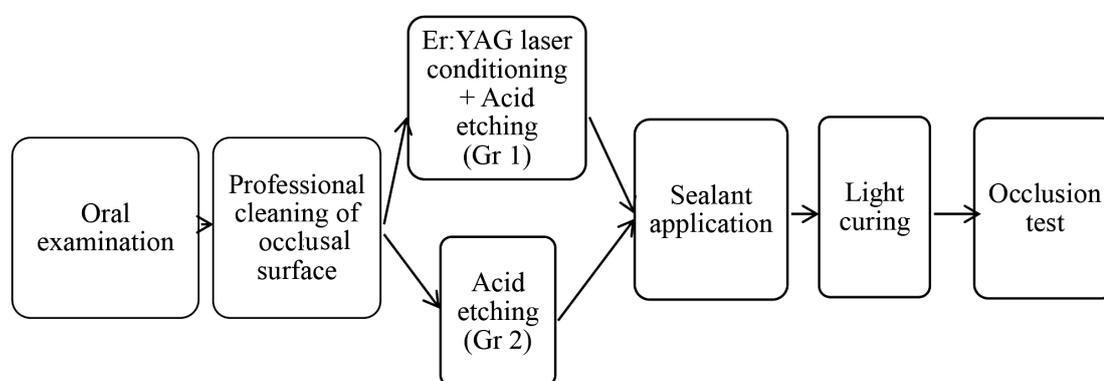


Figure 1. Schematic design of sealant application in the two studied groups.

The present study investigated two physiological objective parameters of stress - heart rate and oxygen saturation, measured with mobile pulse oximeter (CMS50F, CONTEC), placed on the index finger of the left hand (Fig. 3).²⁰ Throughout the whole procedure of sealant application data were recorded and analyzed by a specially developed digital processing and graphic visualization software SPO2 Review V1.2 rel (Fig. 4).

The data obtained were tabulated and subjected to statistical analysis. SPSS 19.0 was used for data analyses. The level for statistical significance was set at $p < 0.05$.

RESULTS

A total of 64 children aged 6-12 (mean age 7.89 ± 1.73 yrs) participated in the study. Simultaneous evaluation

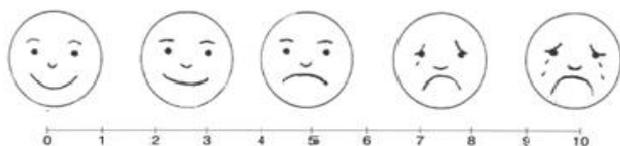


Figure 2. Modified version of the self-report Faces Scale by LeBaron et al.



Figure 3. Mobile pulse oximeter.

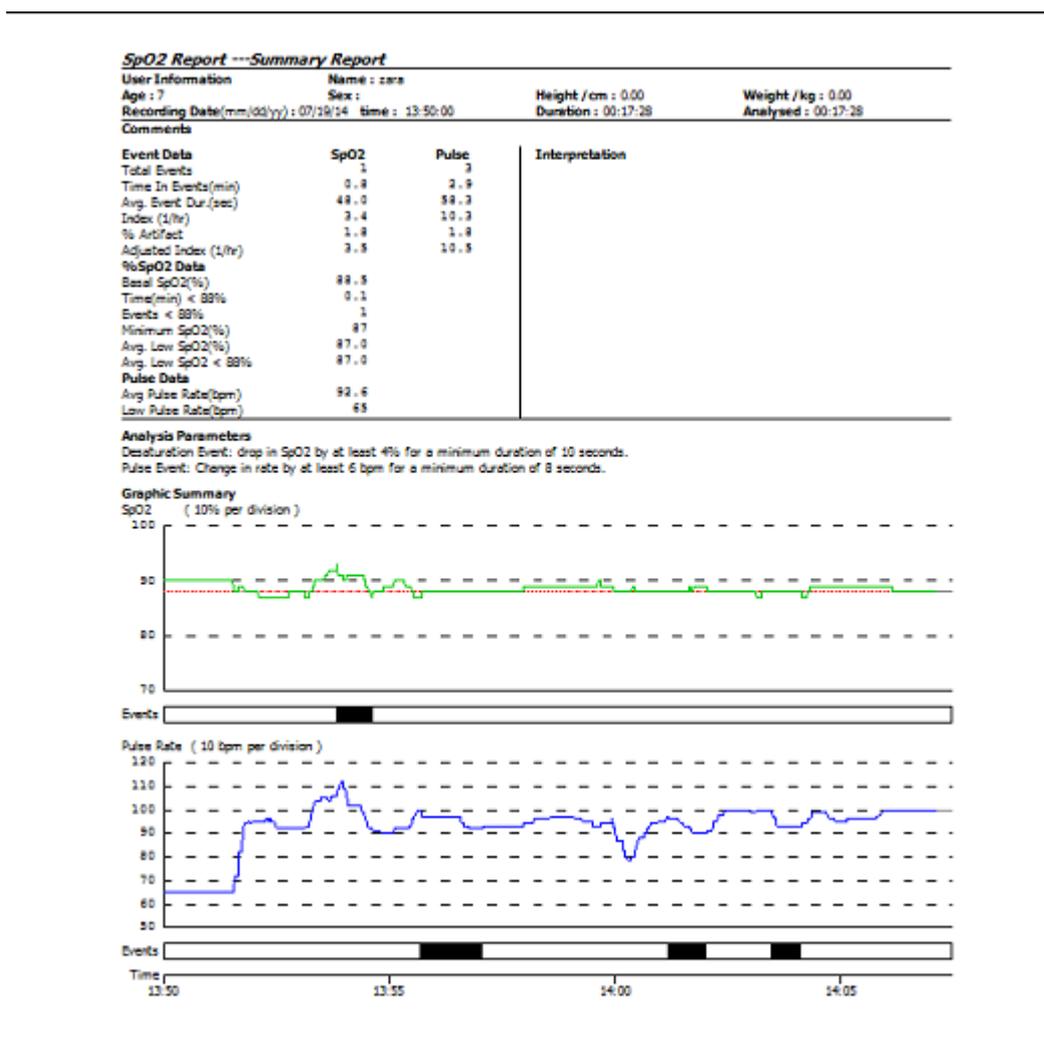


Figure 4. Summary report of the studied parameters.

of the objective and subjective stress parameters was used to obtain more details about the effect of the preventive procedures on dental anxiety in children.

SUBJECTIVE STRESS EVALUATION OF CHILDREN

The patients distribution by anxiety degree before and after the dental visit is shown in **Fig. 5**. Significantly lower degree of the dental anxiety was found at the end of the dental visit of the investigated group of participants ($p < 0.001$) (**Figs 5, 6**). Before the dental visit almost half of the children reported low level of anxiety (43.7%). The proportion of children who indicated no anxiety (21.9%)

and medium level of dental anxiety (23.5%) was approximately equal. One fifth of patients reported high level of anxiety (10.9%) (**Fig. 6**). The results of our study show that after the dental visit the proportion of children who indicate no dental anxiety is the largest (81.3%), while there are no patients who reported high level of anxiety. Only two children reported medium level of anxiety at the end of the dental procedures.

After a careful analysis of the results of our study, we can conclude that the inclusion of an alternative procedure, for example a preventive one, could be a good choice in the treatment of anxious

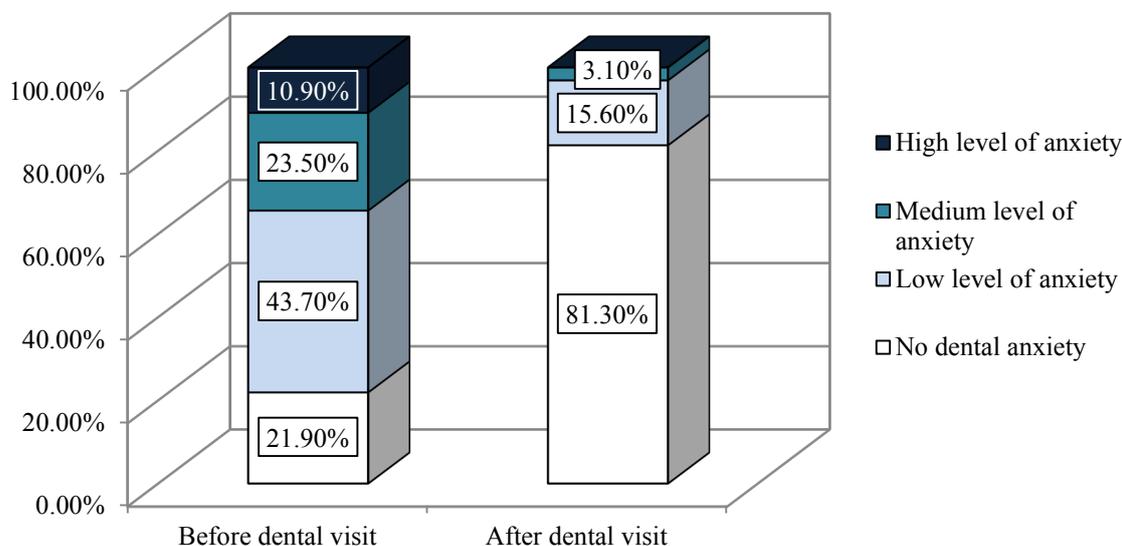


Figure 5. Distribution of the investigated patients into groups before and after the dental visit.

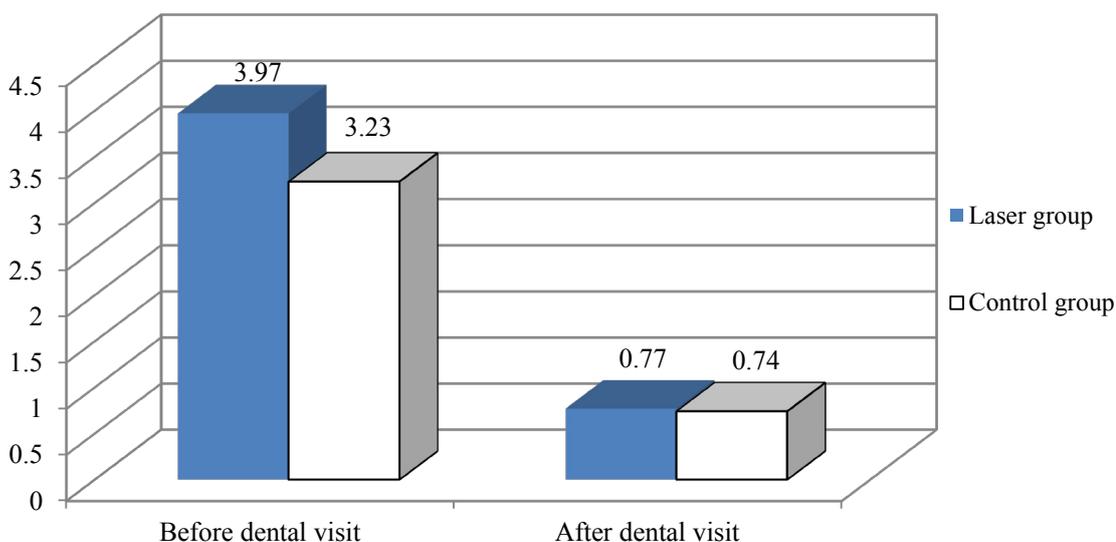


Figure 6. Subjective evaluation of the dental anxiety in the two groups before and after the dental visit.

patients. In this way we offer a new course of dental treatment, different from the routine, which could lead to breaking of the so called ‘vicious cycle of dental fear and anxiety’.²¹⁻²³

Fig. 6 shows that in both groups children are more anxious at the beginning of the dental visit. No significant differences were found for both the initial and final levels of dental anxiety between two studied groups ($p>0.05$).

Another analysis also supports the results obtained. The statistical analysis of the results comparing the mean values of the self-reported dental anxiety after the dental visit shows no significant differences between the two groups ($p>0.05$) (Table 1).

OBJECTIVE STRESS EVALUATION OF CHILDREN

The obtained data show that during the professional cleaning of the tooth surface the mean heart rate was low (95.55 ± 14.29 bpm), within the physiological normal range associated with the age of the middle childhood (Fig. 7).²⁴

The results of our study on the effect of one of the most effective preventive measures - sealant

application - on dental anxiety, show that the mean heart rate was 98.74 ± 12.38 beats per minute in the control group and 96.20 ± 12.27 beats per minute in the laser treated one (Fig. 7). The statistical analysis of the results concerning the dynamics of the physiological stress indicator shows no significant differences between the two groups ($p>0.05$) (Table 2). The data of the present research define the use of Er:YAG laser as non-anxiety-provoking tool in preventive procedures. The obtained results of another statistical analysis comparing the mean values of the self-reported dental anxiety at the end of the procedure between two groups support this conclusion (Table 3).

DISCUSSION

The results of our study show that preventive procedures are well accepted by children and do not cause trait anxiety at the end of the dental visit. The data reported here appear to support the assumption that professional cleaning as a preventive procedure does not provoke dental anxiety in children. It confirms the results of a previous study which showed that the least fearful item in dental envi-

Table 1. Comparison of the mean dental anxiety of the patients in the two groups before and after the dental visit (subjective evaluation).

Group	Time	Before dental visit (I ₁)	After dental visit (I ₂)	I ₁ vs I ₂ p
Laser group		3.97±3.03	0.77±1.41	0.000
Control group		3.23±2.36	0.74±1.46	0.000

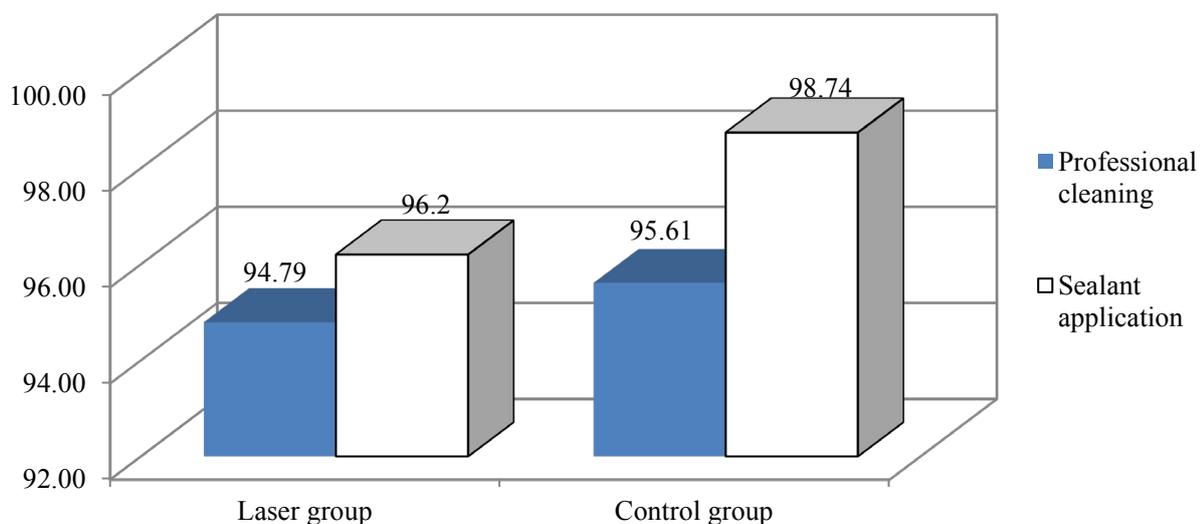


Figure 7. Mean heart rate during the preventive procedures in the two groups.

Table 2. Mean heart rate of the patients during sealant application between two groups (objective evaluation)

Group	Number of patients	mean \pm SD	t	P
Laser group	32	96.20 \pm 12.27	-0.806	0.423
Control group	32	98.74 \pm 12.36		

Table 3. Mean value of the self-reported dental anxiety after sealant application between two groups (subjective evaluation)

Group	Number of patients	mean \pm SD	t	P
Laser group	32	0.77 \pm 1.41	0.067	0.947
Control group	32	0.74 \pm 1.46		

ronment rated by children was 'having the dentists clean your teeth'.²⁵ Therefore, it could be used as an introductory procedure at the beginning of the dental treatment, especially in anxious children.

The results of the present study are in line with the results of a similar study published in 2006 that evaluated dental anxiety in sequential dental visits.²⁶ The authors did not find an increase in the dental anxiety of 115 4-11-year-old children after professional cleaning of teeth. In the specialized dental journals we found only one study investigating the dynamics of the heart rate as a stress indicator during professional tooth cleaning.²⁷ Its authors registered mean heart rate value about 103 beats per minute and no significant increase of the parameter during the procedure. The findings from this study are in line with the results reported by Farhat-McHayleh et al. and Rayen et al., while the found higher mean heart rate value is probably due to the age of the investigated contingent.

The current study investigates the relationship dental anxiety – sealant application in two directions. On one hand, the analysis of the data obtained of the investigated subjective and objective parameters shows that this procedure is non-anxiety-provoking one. Therefore, sealant application could also be used as an introductory effective procedure for managing anxious patients when there are indications for its use. On the other hand, it is of great interest comparing patients' dental anxiety between two groups because of the use of Er:YAG laser in the laser one. According to Frentzen et al. and Caprioglio et al., Er:YAG laser conditioning of fissure system followed by acid etching and before sealant application reduces significantly the micro-

leakage sealant/enamel surface.^{13,14} Thus the present study explores the influence of the additional Er:YAG laser conditioning of the enamel surface on children's dental anxiety. The statistical analysis of the results comparing the mean heart rate shows no significant differences in dental anxiety levels between the two groups ($p > 0.05$ (**Table 3**)). Consequently, the use of Er:YAG laser before sealant application does not affect 6-12-year-old children's dental anxiety. It would be useful for dentists to concentrate on the advantages of the additional application of Er:YAG laser for conditioning of the enamel surface compared to the conventional technique.

To the present authors' knowledge, this is the first report on a clinical trial measuring subjective and objective stress parameters in patients in conjunction with Er:YAG laser application during sealant application. For this reason, the present results could not be compared and discussed with the results of other authors. Further studies should also consider the application of Er:YAG laser in other preventive procedures when examining dental anxiety.

CONCLUSIONS

This study suggests that application of Er:YAG laser in preventive procedures does not provoke dental anxiety and is well accepted by children in dental environment. Preventive procedures at the beginning of dental visit decrease the initial levels of dental anxiety and contribute to an effective treatment process. In summary, they not only decrease the risk for development of oral diseases, but also eliminate or reduce the risk of developing dental

fear and anxiety in children.

REFERENCES

- de Menezes Abreu DM, Leal SC, Mulder J, et al. Patterns of dental anxiety in children after sequential dental visits. *Eur Arch Paediatr Dent* 2011;12(6):298-302.
- Raj S, Agarwai M, Aradya K, et al. Evaluation of dental fear in children during dental visit using children's fear survey schedule-dental subscale. *Int J Clin Pediatr Dent* 2013;6(1):12-15.
- Aartman IHA, van Everdingen T, Hoogstraten J, et al. Self-report measurements of dental anxiety and fear in children: A critical assessment. *ASDC J Dent Child* 1998;65:252-8.
- Coolidge T, Arapostathis KN, Emmanouil D, et al. Psychometric properties of Greek versions of the Modified Corah Dental Anxiety Scale (MDAS) and the Dental Fear Survey (DFS). *BMC Oral Health* 2008;8:29.
- Ammann P, Kolb A, Lussi A. Influence of rubber dam on objective and subjective parameters of stress during dental treatment of children and adolescents - a randomized controlled clinical pilot study. *Int J Paediatr Dent* 2013;23(2):110-5.
- Kervanto-Seppälä S, Pietilä I, Meurman JH, et al. Pit and fissure sealants in dental public health – application criteria and general policy in Finland. *BMC Oral Health* 2009;9:5.
- Avinash J, Marya CM, Dhingra S, et al. Pit and fissure sealants: an unused caries prevention tool. *J Oral Health Comm Dent* 2010;4(1):1-6.
- Hatibovic-Kofman S, Butler SA, Sadek H. Microleakage of three sealants following conventional, bur, and air-abrasion preparation of pits and fissures. *Int J Paediatr Dent* 2001;11:409-16.
- Hatibovic-Kofman S, Wright GZ, Braverman I. Microleakage of sealants after conventional, bur, and air-abrasion preparation of pits and fissures. *Pediatr Dent* 1998;20:173-6.
- Courson F, Renda AM, Attal JP, et al. In vitro evaluation of different techniques of enamel preparation for pit and fissure sealing. *J Adhes Dent* 2003;5:313-21.
- Bagherian A, Akbari M, Rezaeian M, et al. Microleakage assessment of fissure sealant following fissurotomy bur or pumice prophylaxis use before etching. *Dent Res J* 2013;10(5):643-6.
- Borsatto MC, Corona SA, Ramos RP, et al. Microleakage at sealant/enamel interface of primary teeth: effect of Er:YAG laser ablation of pits and fissures. *J Dent Child (Chic)* 2004;71(2):143-7.
- Caprioglio C, Olivi G, Genovese MD. Pediatric laser-assisted dentistry: a clinical approach. *Int Mag Las Dent* 2012;2(1):8-15.
- Frentzen M, Santaella MRLA, Matson E. Er:YAG laser-assisted fissure sealing. *International Congress Series* 2003;1248:197-8.
- Ibaraki Y, Yabuki M, Haraguchi K, et al. The treatment of dental pit and fissure caries by an Er:YAG laser with an experimental tip [abstract 27]. *Yokohama, ISLD congress* 2002:83.
- Parker S. Surgical lasers and hard dental tissue. *Br Dent J* 2007;202(8):445-54.
- Daneswari V, Nandlal B. Restorative dentistry for children using a hard tissue laser – a review. *Int J Oral Health* 2011;3(3):1-10.
- LeBaron S, Zeltzer L. Assessment of acute pain and anxiety in children and adolescents by self-reports, observer reports, and a behavior checklist. *J Consult Clin Psychol* 1984;52:729-38.
- Shindova M, Belcheva A. The effect of parental presence on the dental anxiety during clinical examination in children aged 6-12 years. *J of IMAB* 2013;19(4): 435-8.
- Schriks MC, van Amerongen WE. Atraumatic perspectives of ART: psychological and physiological aspects of treatment with and without rotary instruments. *Community Dent Oral Epidemiol* 2003 31(1):15-20.
- van Wijk AJ, Hoogstraten J. Anxiety and pain during dental injections. *J Dent* 2009;37(9):700-4.
- Thomson WM, Stewart JF, Carter KD, et al. Dental anxiety among Australians. *Int Dent J* 1996 46(4):320-4.
- Berggren U. Dental fear and avoidance: causes, symptoms, and consequences. *J Am Dent Assoc* 1984;109(2):247-51.
- Regulation № 2/04.02.2003 for organization and conduction of preventive examinations and dispensary observation of 0-18 aged insured individuals. *State Gazette* 2003;16:33-40 [Bulgarian].
- Shindova M, Belcheva A, Mateva N. Factors in dental environment related to development of child dental fear and parent-child agreement on its evaluation. *Int Sci J Sci Tech* 2014;4:91-5.
- Rayen R, Muthu MS, Chandrasekhar Rao R, et al. Evaluation of physiological and behavioral measures in relation to dental anxiety during sequential dental visits in children. *Indian J Dent Res* 2006;17(1):27-34.
- Farhat-McHayleh N, Harfouche A, Souaid P. Techniques for managing behaviour in pediatric dentistry: comparative study of live modelling and tell-show-do based on children's heart rates during treatment. *J Can Dent Assoc* 2009;75(4):283.

Влияние Er:YAG лазера на объективные и субъективные параметры стресса в процессе нанесения зубного герметика детям

Мария П. Шиндова¹, Ани Б. Белчева¹, Нонка Г. Матева²

¹ Кафедра детской дентальной медицины, Факультет дентальной медицины, Медицинский университет -Пловдив

² Кафедра медицинской информатики, биостатистики и электронного обучения, Факультет общественного здравоохранения, Медицинский университет - Пловдив

Адрес для корреспонденции:

Мария П. Шиндова, Кафедра детской дентальной медицины, Факультет дентальной медицины, Медицинский университет - Пловдив, бул. „Христо Ботев“ № 3, 4000, Пловдив, Болгария
E-mail: mariya.shindova@gmail.com
Tel: +359 898 390 935

Дата получения: 23 февраля 2016

Дата приемки: 15 августа 2017

Дата онлайн публикации: 25 сентября 2017

Дата публикации: 30 июня 2018

Ключевые слова: тревожность, методы оценки, зубной герметик, профилактика, дети

Образец цитирования:

Shindova MP, Belcheva AB, Mateva NG. Influence of Er:YAG laser on objective and subjective parameters of stress during sealant application in children. Folia Med (Plovdiv) 2018;60(2):275-82.

doi: 10.1515/folmed-2017-0086

Введение: Применение лазеров как альтернатива традиционным методам и в качестве вспомогательных инструментов в стоматологической медицине вызвало взрыв интереса. Использование Er: YAG-лазера рекомендуется для защиты зубной эмали. На данный момент не существует исследований, оценивающих тревожность у детей во время процедур герметизации фиссур при использовании Er: YAG-лазера по сравнению с обычной методикой нанесения.

Цель: Оценить объективные и субъективные параметры стресса у детей во время профилактической процедуры при использовании Er: YAG-лазера для дополнительного эмалирования перед нанесением герметика в ямки и фиссуры по сравнению с обычной методикой клинического применения.

Материалы и методы: Исследование охватывало группу из 64 детей в возрасте 6-12 лет, разделённых на две одинаковые по численности терапевтические подгруппы. Было выполнено стандартизованное нанесение герметика в трещины, а в экспериментальной группе до кислотного травления окклюзионные поверхности зубов были кондиционированы Er: YAG-лазером (2940 нм). В ходе процедуры были зафиксированы объективные и субъективные параметры стресса.

Результаты: Значительно более низкая степень тревожности была установлена в конце посещения стоматолога в экспериментальной группе ($p < 0,001$). Во время профессиональной очистки поверхности зуба средняя частота сердечных сокращений была низкой ($95,55 \pm 14,29$ уд. / мин.) в границах нормальных физиологических колебаний. Объективные и субъективные параметры стресса не показывают существенных различий между двумя подгруппами во время процедуры герметизации ($p > 0,05$).

Заключение: Применение лазера Er: YAG во время процедуры нанесения герметика не вызывает беспокойства и хорошо воспринимается детьми в стоматологической среде. Профилактические процедуры в начале посещения стоматолога уменьшают начальные уровни тревожности и способствуют эффективному процессу лечения.