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Utjecaj sredstva za izbjeljivanje zuba s 10%-tnim karbamidnim peroksidom na zdravlje parodonta

Effects of 10% Carbamide Peroxide Teeth Whitening System on Periodontal Health

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Sažetak

Svrha rada bila je istražiti utjecaj sredstva za izbjeljivanje zuba s 10 %-tnim karbamidnim peroksidom (VivaStyle, Ivoclar Vivadent, Schaan, Liechtenstein) na zdravlje parodonta. U studiju je bilo uključeno 10 ispitanika u dobi od 22 do 29 godina, s klinički zdravim parodontnim tkivima, a željeli su promijeniti nijansu boje zuba. Tijekom 12 dana njihovi su zubi bili svaki dan podvrgnuti jednosatnom tretmanu 10 %-tnim karbamidnim peroksidom. Svi su morali tijekom postupka voditi dnevnik mogućih nelagoda. Na početku - šestog i dvanaestog dana - kod svih ispitanika izmjerene su vrijednosti API-a i PBI-a te su im zubi fotografirani u zagrizu. Svi su zubi postupkom izbjeljeni barem za jednu nijansu. Tijekom tretmana nije bilo promjena ni u akumulaciji plaka, ni u upali gingive. Taj postupak nema nikakva utjecaja na zdravlje parodonta.

Zaprimljen: 5. svibnja 2006.
Prihvaćen: 1. lipnja 2006.

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Ključne riječi

Izbjeljivanje zubi; parodontologija;
karbamid peroksid

Uvod

Izbjeljivanje zuba je elektivni stomatološki tretman koji pridonosi lijepom osmijehu, dojmu mladosti i vitalnosti te povećava samopouzdanje. To je sve popularniji postupak, posebice među mlađim pacijentima. Rasprava o mogućim kancerogenim i štetnim utjecajima izbjeljivanja zuba ako se koristi karbamidni peroksid traje već dugo (1-3), no još nema usklađenih stajališta o tom problemu. U nekim je zemljama čak zabranjena uporaba svih sredstava koja sadržavaju karbamidni peroksid (4). U Europskoj uniji se sredstva za izbjeljivanje smatraju koz-

Introduction

Teeth whitening procedure is an elective dental treatment, one that results in a more pleasant smile, feeling of youthfulness, vitality and increased self-esteem. It is a procedure with an ever-increasing popularity, especially with younger patients. The debate about the potential carcinogenic and damaging effects of teeth whitening or bleaching procedures that use carbamide peroxide has been a lengthy one (1-3), and there is still inconclusive data regarding the issue. In some countries all substances containing carbamide peroxide have been banned

metikom i prodaja tih proizvoda je zabranjena (5). Predvidljivost postupka i njegove moguće štetne posljedice - koliko god bile male – detaljno su istražene (1-3). Do danas nema objavljenih istraživanja o mogućem štetnom utjecaju VivaStyle (Ivoclar Vivadent, Schaan, Liechtenstein) sustava za izbjeljivanje zuba, koji se temelji na 10 %-tnom karbamidnom peroksidu, na zdravlje parodonta, točnije na gingivalni integritet. Zbog toga smo pokušali obaviti istraživanje na dobrovoljcima s klinički zdravim parodontnim tkivom kako bismo mogli detektirati mogući štetni utjecaj odobrenog sustava za izbjeljivanje zuba na marginalna parodontna tkiva. Zato smo pozvali sve pacijente Zavoda za parodontologiju Stomatološkog fakulteta u Zagrebu da sudjeluju u istraživanju, ako žele izbjeliti zube.

Ispitanici i postupci

Izbor dobrovoljaca

Za dobrovoljno sudjelovanje u istraživanju prijavila su se ukupno 23 pacijenta. Odabrani su između onih koji su došli u Zavod za parodontologiju Stomatološkog fakulteta (Zagreb, Hrvatska) u sklopu strogo organizirane potporne terapije. Svi su potpisali pristanak i potvrdili da se slažu sa sudjelovanjem u istraživanju kojim bi se promijenila nijansa boje njihovih zuba. Svim pacijentima obavljen je standardni parodontološki pregled, ali je samo 10 odabrano za sudjelovanje u istraživanju. Sedam kandidata je odbijeno zbog stanja njihova parodonta (uznapredovali gubitak alveolarne kosti), a šest zato što se nisu mogli držati strogog protokola koji im je ponuđen. Od 10 dobrovoljaca, 8 su bile žene i 2 muškarca srednje dobi od $24,6 \pm 2,5$ godina (raspon dobi od 22 do 29 godina). Svi su bili nepušači, s kontinuiranim zubnim lukovima najmanje do drugih premolara.

Na početku postupka dobrovoljci nisu imali kariozne lezije, osjetljivost zubi, amalgamske ispuhe, ni oštećene krunice ili mostove. Nitko od njih nije imao znakove aktivnog gingivitisa ili parodontitisa, kao ni druge kontraindikacije za postupak izbjeljivanja zuba. Uporabljena su dva indeksa za određivanje kliničkog statusa parodontnih tkiva - aproksimalni plakni indeks (API) (6) i indeks krvareće papile (PBI) (7). Inicijalne vrijednosti svih ispitanika bile su od 2 do 19 % (API) i od 1 do 28 (PBI).

from use (4). In the European Union, the bleaching agents are considered to be cosmetics, and the sale of these products is prohibited (5). The predictability of the procedures and their potential damaging consequences, however small they may be, has been studied extensively (1-3). There are no studies that have surveyed potential deteriorating effect of VivaStyle (Ivoclar Vivadent, Schaan, Liechtenstein) – 10% carbamide peroxide teeth whitening system on periodontal health, more precisely, gingival integrity. Therefore, we tried to conduct a survey on volunteers with clinically healthy periodontal tissues in which we would assess the possible damaging effect of approved teeth whitening system on marginal periodontal tissue. For that purpose, we invited all patients from the Department of Periodontology, School of Dental Medicine in Zagreb that were interested in teeth whitening, to take part in the study.

Subjects and Methods

Volunteer selection

In total, 23 patients volunteered for the study. They were selected from the patients that attend the Department of Periodontology at Zagreb School of Dental Medicine (Zagreb, Croatia) as a part of a strictly organized recall. All the 23 patients signed the informed consent in which they accepted to participate in the study and by which they confirmed their wish to change the shade of their teeth. Standard recall periodontal examination was performed on all the 23 patients, but only 10 were elected to participate in the study. Seven were rejected because of their periodontal condition (advanced loss of alveolar bone), while six were unable to follow the strict protocol that was offered to them. Out of ten volunteers, 8 were female and 2 were male, and their mean age was 24.6 ± 2.5 years (age range 22 to 29 years). All volunteers were non-smokers, with continuous arches of teeth to the second premolar.

All volunteers were devoid of carious lesions, teeth hypersensitivity, amalgam restorations, damaged crowns or bridges at the start of the treatment. None of them showed clinical signs of active gingivitis or periodontitis, as well as other clinical contraindications of teeth whitening procedure. Two indices were used for determining the clinical status of periodontal tissues: Aproximal Plaque Index – API (6), and Papillary Bleeding Index – PBI (7). Initial values for all volunteers were 2-19% (API), and 1-28 (PBI).

Postupak

Nakon što su dobrovoljci odabrani, svi su obaviješteni o zadaći istraživanja te su prihvatili predložene upute i složili se s kontrolnim pregledima svakih šest dana tijekom provedbe postupka izbjeljivanja zuba, što je značilo dva kontrolna pregleda na Zavodu (6. i 12. dan).

Tjedan dana prije početka, zubi su im temeljito očišćeni zvučnim aparatom (SonicFlex, KaVo, Biberach, Njemačka) i abrazivnim pastama za poliranje (Proxyl, Ivoclar Vivadent, Schaan, Liechtenstein) na gumicama i četkicama, s različitim vrijednostima (7, 36 i 83) relativne dentalne abrazivnosti (RDA). Uporabom tih proizvoda uklonjene su sve mrlje i naslage. Početna nijansa boje zuba pacijenata određivala se ključem boja (Vita shade guide, Vita Zahnfabrik, Bad Säckingen, Njemačka). U studiju su bili uključeni samo pacijenti čija je početna boja zuba bila barem dvije nijanse tamnija od najsvjetlije nijanse iste boje.

Nakon toga uzeti su alginatni (Dentsply, Milford, USA) otisci i izliveni modeli u tvrdoj sadri. Na modelima su - prema uputama proizvođača - izdiju "mekih folija" pomoću vakuumske termoprese (Erkopress 2002, Erkodent, Pfalzgrafenweiler, Njemačka), izrađene dvije udlage za svakog ispitanika. Izrezane su tako da je njihov rub bio 0,5 mm koronalno odmaknut od ruba gingive. Kasnije istog dana, udlage su isprobane te su uklonjeni svi mogući iritirajući rubovi. Obavljena je demonstracija nanošenja sredstva; dobrovoljci su obaviješteni kako će to učiniti i poslani su kući.

Upute dobrovoljcima

Upute dobrovoljcima bile su sljedeće:

- temeljito očetkajte zube i zubnom svilom očistite sve interdentalne prostore;
- stavite nekoliko kapi sredstva za izbjeljivanje – 10%-tnog karbamidnog peroksida u gelu VivaStyle u svaki prostor na udlagama koji odgovara zubu;
- namjestite udlage u ustima i vatiranim štapićem očistite višak sredstva;
- udlagu nosite jedan sat;
- nakon jednog sata, maknite udlagu i nježno očetkajte zube;
- operite, osušite i spremite udlage u za to predviđenu kutiju;
- tijekom 12 dana provedbe postupka izbjeljivanja i 7 dana nakon toga nemojte piti voćne sokove, kavu, čaj, crveno vino i druge kromogene namirnice.

Technique

After all the selected volunteers were informed about the scope and aim of the study, they accepted the proposed rules and agreed on control visits every six days during the teeth whitening process, totaling to two control visits to the Department (6th and 12th day).

A week before baseline, volunteers' teeth were thoroughly cleaned and scaled, using sonic scalers (SonicFlex, KaVo, Biberach, Germany) and abrasive polishing pastes (Proxyl, Ivoclar Vivadent, Schaan, Liechtenstein) on rubber cups and brushes, with different relative dentine abrasiveness (RDA) values (7, 36 and 83). Using these procedures, all stains and deposits were removed. The initial color of patients' teeth was determined using Vita shade guide (Vita Zahnfabrik, Bad Säckingen, Germany). Only the patients whose initial teeth color was at least two shades darker than the brightest shade of the same color were included in the study.

Subsequently at baseline, alginate (Dentsply, Milford, USA) impressions were taken, and casts were manufactured in hard plaster. On these casts, according to the manufacturer's instructions, out of two "soft foils", two trays were produced by a vacuum thermopress (Erkopress 2002, Erkodent, Pfalzgrafenweiler, Germany). The trays were cut so that the margin of the tray was located 0.5 mm coronally from the gingival margin. Later in the same day, the trays were tried, and all possibly irritating margins were relined. A demonstration of substance application was performed; volunteers were instructed how to perform the application and were sent home.

Volunteer instructions

Instructions for volunteers were as follows:

- thoroughly brush and floss all interdental areas
- apply teeth whitening agent - 10% carbamide peroxide gel VivaStyle in drops, in all teeth impressions in the tray
- position the trays in the mouth. Remove excess by cotton sticks
- wear the trays for one hour
- after one hour, remove the trays and gently brush the teeth
- wash, dry and store the trays in the container
- during 12 days of the treatment and 7 days afterwards, do refrain from fruit juices, coffee, tea, red wine and other chromogenic beverages.

Opažanja i mjerenja

Dobrovoljci su opskrbljeni kompletnim setovima za izbjeljivanje zuba, a sadržavali su 12 doza aktivne tvari. Pozvani su na pregled šesti i dvanaesti dan. Tada je svakome određen API i PBI te su im zubi fotografirani u položaju interkuspidacije.

Dobrovoljci su vodili i dnevnik mogućih neugodnih senzacija ili iritacija tijekom tretmana. Obvezali su se zabilježiti vrijeme, mjesto i prirodu iritacije ili senzacije. Intenzitet se mjerio rasponom od 0 do 5. Na kraju postupka svi su predali dnevnik.

Rezultati su opisani deskriptivnom statistikom i testom ANOVA za ponavljana mjerenja, za što se koristio program Statistica 6,0 (Statsoft Inc., Tulsa, USA).

Rezultati

ANOVA za ponavljana mjerenja pokazala je da tijekom postupka nije bilo utjecaja vremena ni na API ni na PBI (Slika 1.).

Uvidom u dnevnik dobrovoljaca zapažene su tijekom 12 dana trajanja postupka samo dvije znatne nelagode. Riječ je o osjetljivosti zuba kod dvoje ispitanika i gastrointestinalnoj osjetljivosti koju je imao samo jedan dobrovoljac. Dnevni nelagoda sažeti su u Tablici 1.

Observations and measurements

The volunteers were provided with complete sets for teeth whitening, containing 12 doses of the active substance. They were instructed to come on the 6th and 12th day to be examined. At baseline, 6th and 12th day API score and PBI score were measured and clinical photograph of teeth in intercuspitation relation was taken.

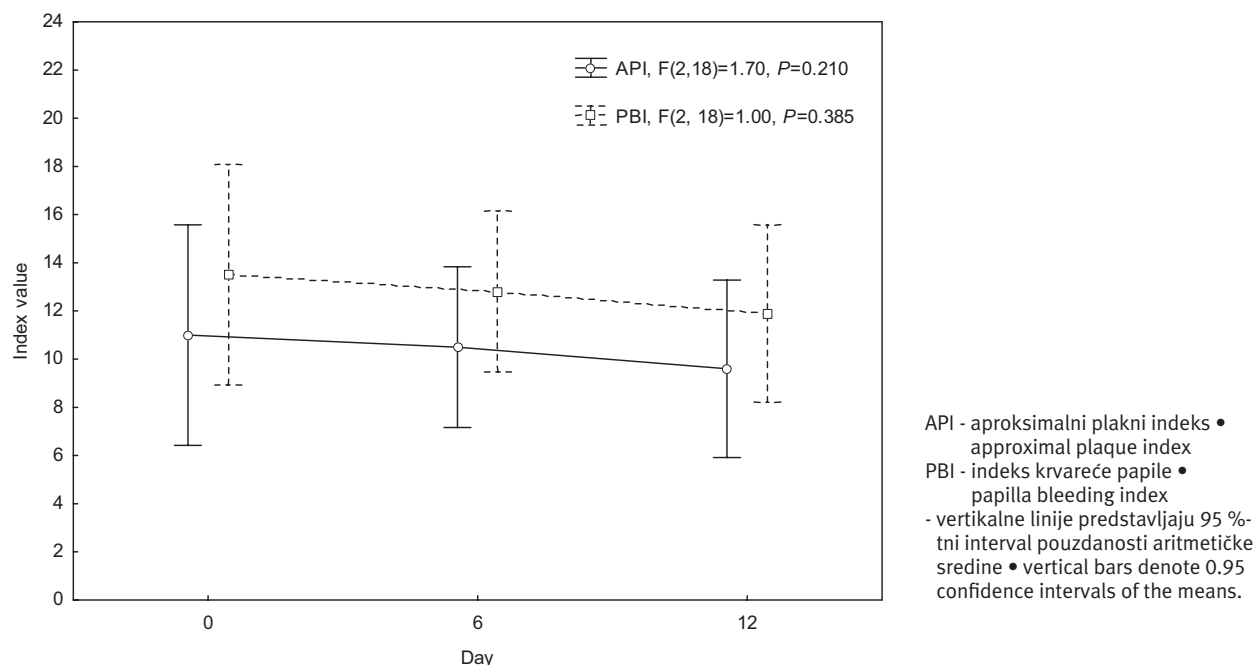
Furthermore, the volunteers were instructed to keep a diary of all possible unpleasant sensations or irritations during the procedure. They were obliged to note the time, location and the nature of the irritation or sensation. The intensity was to be measured by a scale ranging from 0 to 5. All diaries were collected at the end of the procedure.

Descriptive statistics, as well as repeated measures ANOVA analyses were performed using Statistica 6.0 (Statsoft Inc., Tulsa, USA).

Results

Repeated measures ANOVA showed no effect of day neither for API nor PBI during the procedure (Fig. 1).

An insight into volunteers' diaries revealed only two significant disturbances during 12 days of the procedure. These were teeth hypersensitivity, which was present in two volunteers, and gastrointestinal hypersensitivity, which was present in only one volunteer. Diaries of disturbances are summarized in table 1.



Slika 1. Rezultati ANOVE za ponavljana mjerenja za parodontološke indekse API i PBI tijekom istraživanja
Figure 1 Results for repeated measures ANOVA for periodontal indices API and PBI across study

Tablica 1. Pregled dnevnih nelagoda tijekom 12 dana postupka izbjeljivanja zuba
Table 1 Summary of daily disturbances during 12 days of the teeth whitening procedure

Dobrovoljac broj • Volunteer number	Podaci o osjetljivosti/dan • Sensitivity recordings/day											
	1	2	3	4	5	6	7	8	9	10	11	12
1												
2												
3		a	a	a	a							
4												
5												
6				b	b	b	b	b	b			
7												
8												
9							b	b	b	b		b
10												

a – gastrointestinalna osjetljivost • gastrointestinal hypersensitivity
 b – osjetljivost zuba • teeth hypersensitivity

Boja zuba kod svih je posvijetlila barem za jednu nijansu. Kod dvoje pacijenata boja se promijenila čak za tri nijanse.

Rasprava

Između različitih indeksiranih sustava za mjerenje gingivitisa u ovoj kliničkoj studiji odabrani su sustavi API i PBI. Pomoću API-ja možemo detektirati ima li ili nema plaka na aproksimalnim plohama zuba. Striktan je indeks koji ne uzima u obzir količinu plaka nego samo bilježi da li ga ima. PBI kombinira kliničku procjenu upale i krvarenja iz sulkusa i vrlo je osjetljiv indikator upale gingive. Rezultati istraživanja pokazali su da tijekom cijelog tretmana izbjeljivanja zuba nije bilo promjena ni u nakupljanju plaka ni u gingivnoj upali. Zato možemo zaključiti da takav postupak izbjeljivanja zuba nema utjecaja na zdravlje parodonta, točnije na integritet gingive. Naši rezultati u skladu su s rezultatima drugih, te potvrđuju potpunu sigurnost postupka (4, 8) ako se obavlja prema uputama proizvođača. To je inače prvo istraživanje Vivadentova sredstva za izbjeljivanje zuba u Hrvatskoj, a rezultati pokazuju njegovu potpunu sigurnost. Najčešće kliničke popratne pojave koje prate izbjeljivanje zuba kod nekih ispitanika uključuju osjetljivost na temperaturne promjene i oštećenja sluznice usta (3,9). Neka istraživanja pokazala su čak poboljšanja u vrijednostima indeksa (10-12). Osjetljivost zuba često se javlja na početku tretmana i obično je prolazna (3, 13-15). U većini slučajeva vjerojatno su oštećenja sluznice uzrokovale udlage, a ne sredstvo za izbjeljivanje (9, 16). U našem istraživanju nije bilo takvih oštećenja.

The color shade changed in all volunteers for at least one shade. There were two patients whose color shade changed for three shades.

Discussion

Among different measurement indices of gingivitis, for this purpose we used API and PBI systems. By means of API we are able to record presence and absence of plaque on interproximal surfaces of all teeth. It is a strict index system, which does not measure the quantity of plaque, but its presence. PBI combines clinical assessment of inflammation and sulcular bleeding and is a very sensitive indicator of gingival inflammation. Our study revealed no change in either plaque accumulation or gingival inflammation during the teeth whitening procedure. We can conclude that the teeth whitening procedure does not have any influence on of periodontal health, more precisely gingival integrity. Our results support the data reported by others, which confirm the absolute safety of the procedure (4, 8), when it is performed by the manufacturer's instructions. This is the first test performed on the whitening agent by Vivadent in Croatia, and the data shows it is absolutely safe. Most commonly observed clinical side effects include mild tooth sensitivity to temperature changes and irritation of oral mucosa in some patients (3, 9). Some studies even reported improvements in gingival and plaque indices (10-12). Tooth sensitivity often occurs during the early stages of bleaching treatment and is usually transient (3, 13, 14-15). In most cases, it was the tray rather than the bleaching or whitening agent that caused mucosal irritations (9, 16). Our study recorded no such irritations.

Deset postotni karbamidni peroksid kemijsko je sredstvo koje se tijekom aktiviranja u vodenoj otopini raspada na 3% H₂O₂ i 7% ureu (17). H₂O₂ sadržava slobodne radikale snažnog oksidativnog djelovanja koji u izravnom doticaju s mekim tkivima mogu prouzročiti njihovo oštećenje. Da nema navedenih popratnih pojava u ovoj kliničkoj studiji, može se zahvaliti precizno izrađenim udlagama od "mekih folija" koje nisu prekrivale marginalni rub gingive te su tako onemogućile štetne utjecaje tijekom raspadanja karbamidnog peroksida. Ako je ipak neka količina aktivnog sredstva ostala u kontaktu s mekim tkivima, možemo zaključiti da je fiziološki antioksidativni kapacitet bio veći od oksidativnog kapaciteta sredstva.

Obavljeni postupak izbjeljivanja zuba ispunio je očekivanja dobrovoljaca, ali je potrebno istaknuti i to da se – bude li to dobrovoljac želio – postupak može ponoviti ili produljiti.

Nadalje, potrebna su daljnja istraživanja, kako bi se ustanovilo koliko se postupkom izbjeljivanja – zbog oksidacije organskih ili anorganskih komponenata tvrdih zubnih tkiva – oslabljuju caklina i dentin.

Zaključak

Možemo zaključiti da je uporaba sredstva VivaStyle za izbjeljivanje zuba siguran i predvidiv postupak koji ne ometa svakodnevne aktivnosti. Ustanovili smo da je VivaStyle siguran za parodontna tkiva te se može koristiti i kod pacijenata pod potpornom parodontološkom terapijom.

Zahvale

Autori zahvaljuju doktorici Gordani Poropat-Martinis iz Ivoclar Vivadenta na setovima za izbjeljivanje zuba.

Ten percent carbamide peroxide is a chemical agent that once activated in a water solution, dissolves to 3% H₂O₂ and 7% urea (17). H₂O₂ contains free radicals with strong oxidative potential that may damage soft tissues once they get in contact with them. The absence of these side effects may be attributed to precisely fabricated "soft foils" that were not covering the marginal gingival tissue, therefore disabling the adverse effects of carbamide peroxide deterioration procedure. Even if there was some abundance of the active agent, we can contemplate that the physiologic antioxydative capacity was higher than the oxidative capacity.

Teeth whitening procedure satisfied the volunteers' demands, but it should be pointed out that, depending on the volunteer's wish, the procedure can be either repeated or prolonged.

Further study is, however, needed in order to establish the magnitude of enamel and dentine weakening by the bleaching or whitening procedure because of the oxidation of organic or inorganic components of the hard tooth tissue.

Conclusion

We can confirm that the use of VivaStyle whitening agent is a safe and predictable procedure that does not interfere with everyday life. We have established that it is safe for periodontal tissues, and can safely be used in patients in supportive periodontal therapy as well.

Acknowledgments

The authors wish to thank Dr. Gordana Poropat-Martinis from Ivoclar Vivadent for providing the teeth whitening sets.

Abstract

The aim of this study was to examine the effects of a 10% carbamide peroxide bleaching gel (VivaStyle, Ivoclar Vivadent, Schaan, Liechtenstein) on periodontal health. Ten participants, 22 to 29 years of age, with clinically healthy periodontal tissues and a wish to change the shade of their teeth, participated in this study. Subjects were treated with 10% carbamide peroxide for one hour daily during 12 days. The volunteers were instructed to keep a diary of possible disturbances during the teeth whitening procedure. At baseline, on 6th and on 12th day API score and PBI score were measured and clinical photograph of teeth in intercuspitation relation was taken. All teeth demonstrated change of at least one shade. There was no change in either plaque accumulation, or gingival inflammation during the teeth whitening procedure. This teeth whitening procedure seems not to have any influence on the periodontal health.

Received: May 5, 2006

Accepted: June 1, 2006

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Key words

carbamide peroxide; tooth bleaching; periodontics

References

1. Dahl JE, Pallesen U. Tooth bleaching - a critical review of the biological aspects. *Crit Rev Oral Biol Med.* 2003;14(4):292-304.
2. Attin T, Hannig C, Wiegand A, Attin R. Effect of bleaching on restorative materials and restorations - a systematic review. *Dent Mater.* 2004;20(9):852-61.
3. Munro IC, Williams GM, Heymann HO, Kroes R. Tooth whitening products and the risk of oral cancer. *Food Chem Toxicol.* 2006;44(3):301-15.
4. Li Y. The safety of peroxide-containing at-home tooth whiteners. *Comped Contin Educ Dent.* 2003;24(4A):384-9.
5. Morris CD. Tooth whiteners D the legal position. *Br Dent J.* 2003;194(7):375-6
6. Lange DE. *Parodontologie in der täglichen Praxis.* Berlin: Quintessenz; 1986.
7. Saxer UP, Muhlemann HR. Motivation and education. *SSO Schweiz Monatsschr Zahnheilkd.* 1975;85(9):905-19.
8. Ritter AV, Leonard RH Jr, St Georges AJ, Caplan DJ, Haywood VB. Safety and stability of nightguard vital bleaching: 9 to 12 years post-treatment. *J Esthet Restor Dent.* 2002;14(5):275
9. Li Y. Toxicological considerations of tooth bleaching using peroxide-containing agents. *J Am Dent Assoc.* 1997;128 Suppl:S31S-6.
10. Brunton PA, Ellwood R, Davies R. A six-month study of two self-applied tooth whitening products containing carbamide peroxide. *Oper Dent.* 2004;29(6):623-6.
11. Almas K, Al-Harbi M, Al-Gunaim M. The effect of a 10% carbamide peroxide home bleaching system on the gingival health. *J Contemp Dent Pract.* 2003;4(1):32-41.
12. Curtis JW, Dickinson GL, Downey MC, Russell CM, Haywood VB, Myers ML et al. Assessing the effects of 10 percent carbamide peroxide on oral soft tissues. *J Am Dent Assoc.* 1996;127(8):1218-23.
13. Tredwin CJ, Naik S, Lewis NJ, Scully C. Hydrogen peroxide tooth-whitening (bleaching) products: Review of adverse effects and safety issues. *Br Dent J.* 2006;200(7):371-6.
14. Donly KJ, Kennedy P, Segura A, Gerlach RW. Effectiveness and safety of tooth bleaching in teenagers. *Pediatr Dent.* 2005;27(4):298-302.
15. Berga-Caballero A, Forner-Navarro L, Amengual-Lorenzo J. At-home vital bleaching: a comparison of hydrogen peroxide and carbamide peroxide treatments. *Med Oral Patol Oral Cir Bucal.* 2006;11(1):94-9.
16. Rosenstiel SF, Gegauff AG, Johnston WM. Randomized clinical trial of the efficacy and safety of a home bleaching procedure. *Quintessence Int.* 1996;27(6):413-24.
17. Basting RT, Rodrigues Junior AL, Serra MC. The effect of 10% carbamide peroxide bleaching material on microhardness of sound and demineralized enamel and dentin in situ. *Oper Dent.* 2001;26(6):531-9.