

# **“No More Little White Lies”** **Evidence Based Tooth Whitening**

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## **Introduction and In-Office Bleaching**

### **Introduction**

- Restorative Dentistry is changing. “The more we cut tooth, the more we weaken tooth.”
- We have been trained mostly in “mechanical dentistry” however now we must also become trained in “chemical dentistry”.
- “It seems that everybody in America wants whiter teeth to make them feel younger and provide beautiful smiles with accompanying increase in self-esteem”.  
Christensen, JADA 133:1277;2002.
- Bleaching works, but how do we present it?
- To promote bleaching have posters, offer staff bleach or discuss color at restorative appointment. Ask “How do you like your teeth?” or “Are you pleased with the color of your teeth”.
- Listen, evaluate, discuss bleaching with patients. Beware of patients with unrealistic expectations.
- “Tooth shade is indeed the most important variable of the attractiveness of a smile.”  
Dunn et al., J Prosthodont 5:166-171;1996
- Teeth are rated as the most important facial feature.  
Jornung et al., JADA 138:1544;2007.
- A smile has been said to be among man’s most important interactive communication skills.  
Hattab et al., J Esthet Dent 11:291;1999.

### **Goal is to remove stain**

- Extrinsic—Stain, which is deposited on the outside surface.  
Whiteners will lighten calculus and the subsurface structure.
- Stain returns more rapidly if you do not do a dental prophylaxis before bleaching,  
Collins et al. 79:583(#3517);2000
- Intrinsic—Stain, which is incorporated into the tooth structure before or after eruption.  
Tooth whiteners penetrate tooth surface to affect the color.
- As we age our teeth become darker, more yellow and slightly more red.  
Odioso, Compendium 21:S35-S41;2000
- “Patients and consumers now demand not only a healthy mouth but also a perfect smile.”  
Joiner, J Dent 32(Sup 1):3-12;2004

### **In-Office Bleaching**

- Respondents’ satisfaction with In-office bleaching:  
Very satisfied-16%, Satisfied 32%, Unsatisfied 23%, Very unsatisfied 5%  
CRA Newsletter 29(10):2;2005
- Advantages-Rapid tooth whitening; no gel ingested.
- Disadvantages- Greater sensitivity; rapid reversal of tooth whitening; cannot use it on people who are taking medications that make them sensitive to light; possible “burning” of tissues.
- Important to isolate with rubber dam or resin dam from the strong concentrations of bleaching agents.
- Overview of In-office bleaching products. Basic details from manufacturers on 14 systems.  
Freedman, Dental Products Report 36:82;2002

- In vivo* study of eight In-office bleaching systems: A pilot study (alphabetical order).  
 Manufacturer's were invited to come observe use of their product.
 

Accelerated In-Office by Life Like	ArcBrite by Biotrol
Illumine by Dentsply	BriteSmile by BriteSmile
Niveous by Shofu	PolaOffice by Southern Dental Industries
One Hour Smile by Den-Mat	Zoom! by Discus Dental

  - \*Matis et al., Op Dent 28:324;2007
- Effectiveness of In-office products evaluated with and without use of light.
 

Opalescence Xtra Boost	PolaOffice	Rembrandt Lighten Plus
LumaArch	Niveous	LaserSmile
Zoom!		

  - One-week recall shows that light use does not increase whitening over non-light use.
  - CRA Newsletter 27(3):3;2003
- A systemic review of external bleaching therapy with activation by heat, light and laser looks at 5 categories of studies.
  - Buchalla et al., Den Mat 23:586;2007
- In vitro study of 35% HP gel with control, halogen, LED and laser
  - Marston et al., Op Dent 33:81;2008
- Study claims light augments whitening with peroxide.
  - Tavares et al., JADA 134:167;2002
- In vivo pilot study using two products with and without the same light activation.
  - Matis, Unpublished
- Study comparing two In-office systems
  - Gallagher et.al., J Clin Dent 6:219;2002
- The effect of intrapulpal temperature rise on vitality of pulp in Rhesus monkeys.
  - Zach et al., O Surg, O Med, O Path 19:515-530;1965
- How much temperature rise occurs on gel and intrapulpal area during light enhanced bleaching?
  - Baik et al. J Esthet Restor Dent 13:370;2001
- Effects of In-office tooth whiteners on hardness and surface finish of tooth colored restoratives.
  - Both are material dependent and minimally affected by bleaching agents.
  - \*Yap et al. Op Dent 27:137-141;2002
  - \*Watanapayungkul et al. Op Dent 28:15;2003
- Effect on enamel micromorphology when 38% HP used in an *in vivo* study on teeth.
  - Cadenaro et al., Op Dent 33(2):127-134;2008
- ADA accepted In-office product used in a study with an ADA accepted At-home product.
  - \*Zekonis et al., Op Dent 28:114-121;2003
- Will tray bleaching boost In-office bleaching?
  - Matis et al., Submitted for publication
- In-office agents should be used when patients want rapid tooth whitening or when they cannot wear a tray. When possible have patient use tray whiteners to "boost" In-office whiteners.
  - Matis, J Esthet Restor Dent 16:87-88;2004

## **Summary and Conclusions**

- 1) The more we cut tooth, the more we weaken the tooth.
- 2) Tooth shade is the most important element of patients' perception of dental attractiveness.
- 3) When patients come in, Listen, Evaluate and Discuss bleaching with them to make sure you can meet their expectations.
- 4) Accomplish dental prophylaxis so stain is slower to return.
- 5) Main purpose of whitening agents is to remove intrinsic staining.

- 6) Isolation of soft tissues is a must with In-office bleaching.
- 7) Light activation does not appear to increase tooth lightening effect of bleaching.
- 8) Systemic review on additional activation concludes it is debatable if it produces superior tooth whitening.
- 9) Excessive length of light on one tooth can cause injury to the pulp.
- 10) High concentrations of peroxide do not affect hardness or surface finish of dental materials. Hardness and surface finish are material specific.
- 11) No effect on micromorphology found with 38% HP used in vivo.
- 12) At-home is more effective than In-office bleaching using ADA accepted products.
- 13) Follow In-office bleaching with use of At-home tray whitening gel.

## At-Home Bleaching- The Science

### At-Home Bleaching

-Respondents' satisfaction with At-home bleaching:

Very satisfied-49%, Satisfied 45%, Unsatisfied 1%, Very unsatisfied 1%  
CRA Newsletter 29:2;2005

-Advantages-Less tooth sensitivity, more effective.

-Disadvantages-Not predictable, takes longer.

### Concentrations to use

-Effectiveness of different concentrations of carbamide peroxide: An *in vitro* study has shown it just takes longer with lower concentrations.

Leonard et al., Quint Int 29:503-07;1998

-“Inherent Lightness Potential” occurs in teeth, where teeth will get only so light.

-American Dental Associations (ADA) first guidelines on safety and efficacy of bleaching agents were issued in 1994.

J Am Dent Assoc 125:1140-42;1994

-Efficacy standard was revised in 2006.

-The following product is accepted as safe and effective by the ADA.

Opalescence Whitening Gel **10% CP**

[http://www.ada.org/ada/seal/adaseal\\_consumer\\_shopping.pdf](http://www.ada.org/ada/seal/adaseal_consumer_shopping.pdf) May 2008

-Scandinavian Institute of Dental Materials has also recommended “to avoid using concentrations higher than 10% carbamide peroxide”.

Dahl & Pallesen, Crit Rev Oral Biol Med 14:229;2003

-European Commission's Scientific Committee on Consumer Products (SCCP)

1. Use of products up to 0.1 HP is safe.
2. Use of products from 0.1-6% is safe with approval of dentist.
3. There is an absence of studies on adverse effects in mouth.
4. Over-the-counter products should not be available.

\*[http://europa.eu.int/comm/health/ph\\_risk/committees/04\\_sccp/docs/sccp\\_o\\_022.pdf](http://europa.eu.int/comm/health/ph_risk/committees/04_sccp/docs/sccp_o_022.pdf)

### How to make and deliver bleaching tray:

-Procedure for making tray:

Make stone model

Reduce to approximately one inch high

Place resin using palm method

Vacuum form plastic (allow to droop 1 inch, cool model on platform)

Gross reduction on model

Carefully lift tray off model

Trim to cervical margin (indicated by transparent area)

- Reverse directions on trimming
- Instructions for use:
  - Thoroughly brush teeth
  - Express agent into reservoirs
  - Seat tray and express excess
  - Brush off excess
  - Rinse twice with water
  - Remove residual gel after removing tray in morning

#### Studies to review effectiveness of whitening agents

- Efficacy of 10% CP used for two weeks shows 20% large change, 50% moderate, 20% slight and 10% none.
  - Matis et al., Quint Int 29:555;1998
- All had at least **24 subjects**, bleached for **14 days** and **used reservoirs** in trays.
- All maxillary anterior teeth evaluated for color **objectively** and **subjectively**.
- Compare three studies
  - 10% CP and 15% CP, overnight.
    - Matis et al., Quint Int 31:303-310;2000
  - 15% CP and 5.5% HP, ½ hour 2X daily.
    - Panich, Masters Thesis, IUSD, 1999
  - 20% CP and 7.5% HP, 1 hour 2X daily.
    - Mokhlis et al., J Am Dent Assoc 131:1269-1277;2000
- CP has same bleaching capacity as HP at comparable concentrations.
- Color reversal plateaus between 1 and 4 weeks post-bleaching.

#### Histological changes after bleaching

- Penetration of the pulp chamber by carbamide peroxide bleaching agents occurs very rapidly, within fifteen minutes.
  - Cooper et al., J of Endo 18:315;1992
- Mild histological changes that were observed with 10% CP used overnight are considered to be reversible. No moderate or severe histological changes observed.
  - Gonzalez-Ochoa, J. Masters Thesis IUSD 2002

#### Sensitivity

- Tray alone causes tooth sensitivity in 15-20% of patients, add placebo agent and 20-30% report tooth sensitivity, add active agent instead of placebo and 55-75% report tooth sensitivity.
  - Haywood, J Dent Res 79:519(#3001);2000
- To reduce tooth sensitivity:
  - Have patient use agent with potassium nitrate after bleaching for 10-30 minutes.
  - Have patient use agent less often.
  - Have patient wear the tray for a shorter period of time.
    - Haywood, Quint Int 32:105-09;2001
- Potassium nitrate gel faster acting than toothpaste.
  - Haywood, Dental Products 43:82;2000
- Sodium Lauryl Sulfate may cause gingival irritation and aphthous ulceration in some patients.
  - Pure gel does not cause sensitivity.
- To reduce tissue sensitivity, have patient more effectively remove excess bleaching agent that comes out of the tray and have tray trimmed shy of cervical collar of gingiva.
- Severe sensitivity experienced by about 10%--always subsides post-operatively.

### PF and ACP

- PF and CPP-ACP are equally effective desensitizing agents.  
Duan et al. Op Dent (submitted for publication)
- Potassium nitrate and amorphous calcium phosphate are effective in bleaching agents.  
\*Matis et al., Op Dent 32:549;2007
- Use of PF will make tooth more resistant to caries.  
\*Al-Qunaian, Op Dent 30:265;2005

### Adhesion to enamel and dentin

- Adhesion of composite to enamel is affected by bleaching.  
Titley et al., J Endo 19:112,1993
- Study *in vivo* completed recently showed changes in shear bond strength returned to baseline values two weeks after bleaching.  
\*Metz et al., Op Dent 32(5) 427:2007
- Why not place resin immediately after bleaching?  
Cannot bond properly because of oxygen inhibition internally.  
Cannot color match because color reversal will occur.
- Use 10% Sodium Ascorbate (Vit C) to increase adhesion to enamel immediately after bleaching.  
Turkun et al., J Oral Rehab 31:1184;2004
- Longer light activation causes more polymerization.  
Breschi et al. Am J Dent 20:275;2007
- There is no loss of adhesion to dentin after bleaching.  
Freitas et al., JDR 80:247(Abst 1691) 2001

### Microhardness effect of bleaching on enamel and dentin

- Studies differ in loss of microhardness. Depends on tooth source, bovine vs human, depends on if samples placed in distilled water, artificial saliva or in situ.  
Araujo et al. J Esthet Restor Dent 15:166;2003
- Study *in vivo* shows no changes in microhardness after bleaching for two weeks.  
\*Metz et al., Op Dent 32(5) 427:2007
- Direct application and indirect application of bleaching agents on dentin fracture toughness.  
Tam et al., J Dent Res 86:1193;2007
- Review of the effects of peroxide on enamel and dentin properties.  
Joyner, J Dent 35(12):889;2007

### Effect on restorative materials after at-home bleaching

- Six materials were tested for microhardness after bleaching with 15% CP for up to one month.  
Polydonou et al., JADA 138:978,2007
- A SEM evaluation of 6% hydrogen peroxide whitening gel on dental materials *in vitro*.  
Schemehorn et al. J Dent 32:35;2004

### Degradation (determined by recovery of agent)

- Do different patient's saliva degrade gel at different rates?  
Matis, Unpublished 1998
- Does pellicle affect rate of degradation?  
Wattanapayungul et al., Quint Int 30:737;1999

- Rapid initial degradation of carbamide peroxide agent and then it slows down.
  - 87% of agent recoverable after 15 seconds *in vivo*
  - 66% of agent recoverable after 1 hour *in vivo*
  - 53% of agent recoverable after 2 hours *in vivo*
  - 31% of agent recoverable after 4 hours *in vivo*
  - 18% of agent recoverable after 6 hours *in vivo*
  - 6% of agent recoverable after 10 hours *in vivo*
  - Matis et al., J Am Dent Assoc 130:227-235;1999
- Causes of loss of recoverable agent: absorbent tooth (13%); physical loss of agent (14%), anti-oxidant degradation/Increased temperature/product degradation (42%)
  - \*Matis, Compendium 24(SI4A):354-362;2003
- Does degradation happen at the same rate with different concentrations at 2 hours?
  - Matis et al., Op Dent 27:12;2002
- More rapid degradation of hydrogen peroxide
  - 61% of agent recoverable after 5 minutes *in vivo*
  - 56% of agent recoverable after 10 minutes *in vivo*
  - 49% of agent recoverable after 20 minutes *in vivo*
  - 44% of agent recoverable after 30 minutes *in vivo*
  - 38% of agent recoverable after 45 minutes *in vivo*
  - 32% of agent recoverable after 60 minutes *in vivo*
  - Al-Qunaian et al., Op Dent 28:236-241;2003
- With short term use no difference in clinical lightening of teeth with or without reservoirs
  - \*Matis et al., Op Dent 27:5-11;2002
- How long to use agent. When cuspids become as light as central and lateral incisors.
- Deliver maxillary tray first so patients can see the amount of bleaching that has occurred.
- Rebleaching-- should be done when needed, about every 1-3 years.
- How fast? One day of rebleaching for every 5-7 days of initial bleaching.
- Can we get teeth as light as patients would like them? Only with crowns!
- How long does tooth whitening last?
  - Leonard et al., J Esthet Rest Dent 15:142-152;2003
- Can a patient over bleach—if so, when do you stop bleaching? When cuspids become as light as the central and lateral incisors.

#### Over-the-counter tooth whitening agents

- American Dental Association's requirements for the Seal of Acceptance for toothpastes is much different than the requirement for the Seal of Acceptance for tooth whiteners.
- Tooth pastes containing peroxide lighten teeth, but very slowly.
- Whitening toothpaste decreased reversal of color that happens after vital tooth bleaching.
  - Matis, Indiana Dent J 77(3):27-32;1998
- Peroxide release from different systems.
  - Hanning et al., Am J Dent 18:13;2004
- What is their effectiveness in bleaching? For six Vita tab changes; Strips (30 min)=31 cycles, At-home (8 hours)=7 cycles, In-office (15 min)= 3 cycles.
  - Aushill et al., Op Dent 30:156;2005
- Whitening wraps were more effective than Whitestrips Premium.
  - \*Matis et al., Op Dent 30:588;2005
- Trayless bleaching products similar in effectiveness. Treswhite should be used for 60 minutes.

- Paint-on gels showed better tooth whitening results than toothpastes.  
Matis, Unpublished
- When patients ask about over-the-counter bleaching I tell them:  
Gel is usually higher percentage than recommended.  
It is entry level bleaching  
Works, but not as well as tray bleaching  
ADA accepts only 1 product. It has 10% CP.
- Review of bleaching-compared 9 studies from IUSD printed in peer reviewed literature  
Matis et al., Op Dent (submitted) Attachment 1 and Attachment 2

### Toxicity

- “All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy.” Paracelsus (1493-1541)
- Daily ingestion of CP should not exceed 10mg. Includes safety factor of 100.  
Dahl and Becher, J Dent Res 74:710-14;1995
- Should children bleach?  
Am Acad Ped Dent Reference Manual 46;2007
- Does one need to limit chromatogenic causing foods during bleaching? nly coffee and tea have been shown to affect teeth negatively  
Matis, Unpublished
- Use of peroxide does not cause oral cancer.  
Munro et.al., J Esthet Rest Dent 18:119;2006.
- Excellent article entitled “Biological Properties of Peroxide-containing Tooth Whiteners” is available.  
Li, Food and Chemical Toxicity 34;887-904;1996
- Excellent book on bleaching entitled “Bleaching Techniques in Restorative Dentistry” by Linda Greenwell, published by Martin Dunitz, London, England.  
Matis, Op Dent 27;103;2002 Book reviewed
- New book entitled “Tooth Whitening: Indications and Outcomes of Nightguard Vital Bleaching”  
By Van Haywood, Published by Quintessence International

### **Summary and Conclusions**

- 1) 98% of patients are “very satisfied” or “somewhat satisfied” with At-home tooth bleaching.
- 2) Lower concentrations just take longer to lighten teeth a comparable amount.
- 3) Only 10% carbamide peroxide bleaching agents are accepted as “safe” and “effective”.
- 4) Trays need to be made on carefully poured arch models so they fit well.
- 5) Show patients how to use product so they do not waste or ingest bleaching agent.
- 6) Color change plateaus between 2 and 4 weeks.
- 7) Carbamide peroxide and hydrogen peroxide lighten at the same rate in short periods of time. Carbamide peroxide is more effective in longer periods of time.
- 8) Both HP and CP penetrate to the pulp chamber within 15 minutes with in vitro testing.
- 9) 10% CP has been shown histologically to cause some mild but reversible changes in the pulp.
- 10) Tooth sensitivity can be reduced by using potassium nitrate, reducing frequency of bleaching or bleaching for shorter periods during the daytime.

- 11) Tissue sensitivity can be reduced by trimming the tray length and/or removing the product from off the tissues.
- 12) Potassium Nitrate and Fluoride (PF) and Amorphous Calcium Phosphate (APF) are equally effective in reducing sensitivity.
- 13) Caries susceptibility decreases with PF and stays the same even with 35% HP
- 14) Shear bond strength of resin to enamel is reduced with bleaching, but returns to baseline in 2 weeks post bleaching.
- 15) Microhardness in enamel does not change using up to 15% CP during bleaching.
- 16) Resin restorations should not be placed for up to two weeks post-bleaching.
- 17) Restorative materials do not degrade during bleaching.
- 18) After two hours about 50% of the initial concentrations of carbamide peroxide is remaining when reservoirs are used. Less amount of active agent is remaining if reservoirs are not used.
- 19) Presence of pellicle does not affect bleaching effectiveness.
- 20) Patients will ingest 50% more peroxide when trays are used without reservoirs.
- 21) Only about 13% of the active agent is used for the bleaching process.
- 22) After 20 minutes about 50% of the initial active hydrogen peroxide is remaining in trays.
- 23) Reservoirs are needed for overnight bleaching.
- 24) Use of whitening toothpastes with peroxide will slow down post operative reversal of bleached teeth.
- 25) Most over-the-counter products containing peroxide will lighten color of teeth.
- 26) Systems from most to least effective: At-home nighttime, At-home daytime, In-office, Over-the-counter.

### **Clinical Cases: The Proof is in the Taste**

- 1) 4 year old who fell down, traumatizing deciduous central incisors, which were bleached for a total of 47 hours.  
Brantly et al. Ped Dent 23:514;2001
- 2) 19-year-old male, endodontically treated N 11, placed glass ionomer plug, bleached internally and externally for 2 weeks each. Followed for 2 months post-bleaching.
- 3) 36-year-old female, trauma caused discoloration of tooth N 11, no periapical pathology, bleached 6 weeks. Followed for 4 months post-bleaching
- 4) 28-year-old male, semi-professional football player/student, canal in tooth N 21 calcified and tooth discolored, bleached for 5 weeks, rebleached after 9 months.
- 5) 62-year-old female bleached mandibular teeth 6 weeks. Followed for 2 months post-bleaching.
- 6) Lightened stained craze line on N 21 on 66-year-old female. Followed for 4 months post-bleaching
- 7) Hypocalcified area was bleached for 14 days, white spot lightened rapidly then returned to original color after cessation of bleaching.
- 8) Unhappy person who was dissatisfied with vital bleaching and decided on veneers.

### **Fluoride staining- a post eruptive stain**

-Remove fluoride staining in enamel three ways: Microabrasion with HCl acid, beaching and/or use bur to remove stain

Croll, JADA 128:S45-S50;1997

### Tetracycline staining- a pre-eruptive stain

-Not all tetracycline staining can be bleached

-Study in China on subjects with tetracycline staining, using different concentration of gel determined that 10% CP was effective in removing stain. Cervical area is the most difficult area for stain removal.

Matis et al., Quint Int 33:645;2002

#### Clinical cases of Bleaching Tetracycline Stained Teeth

- |                        |                     |
|------------------------|---------------------|
| 1) Homogenous Staining | Right 15%- Left 20% |
| 2) Incisal Staining    | Right 10%-Left 20%  |
| 3) Cervical Staining   | Right 20%-Left 15%  |
| 4) Bands of Staining   | Right 20%-Left 15%  |

### **Summary and Conclusions**

- 1) Traumatized deciduous teeth can be bleached successfully—however children do not like to wear mouthguard.
- 2) In discolored asymptomatic teeth without periapical pathology bleach without root canal treatment.
- 3) In nonvital bleaching seal orifice to canal with glass ionomer and leave open during bleaching. Seal tooth with glass ionomer as resin will not adhere to cavosurface area.
- 4) Anytime dentin is dark bleaching will work, but it takes longer.
- 5) Light spots in some teeth turn lighter very rapidly but reverse to original lightness.
- 6) Other teeth develop white spots during bleaching which indicate less dense enamel areas. These white spots disappear after bleaching is discontinued.
- 7) Teeth will rebleach 5 times faster than they initially bleach.
- 8) Bleaching usually removes fluorosis and it does not return.
- 9) Some teeth with tetracycline staining may take longer than six months to lighten, especially in the cervical area.
- 10) More than 50% of the tooth lightening in tetracycline cases occurred did so in the first month.
- 11) Significantly more subjects had sensitivity in the study on bleaching tetracycline stained teeth on the sides using 15% and 20%.

Never promise results but help patients understand the possibilities!

**End of Course**    **Thank you for your attention**

\* Articles are available on Dr Matis' web site- [www.bamatis.com](http://www.bamatis.com)

## **Questions patients often ask and their answers**

How long do I use the product?

Usually from 2-4 weeks. (On some teeth that are yellow due to aging, I have used the agents for 2 months. Use it as long as teeth continue to lighten. Dr. Haywood has used agents for 12 months on tetracycline stained teeth.)

When will I notice some effect?

In about three days.

What if I cannot wear the tray all night?

Wearing the tray is usually not a problem. The tray is like a contact lens; it stays in place with the gel. Some people will salivate more the first couple of nights. If you find you cannot sleep with it through the night we will have you wear it in the morning or evening for a couple of hours. That way will just take a little longer .

What happens if I miss a day?

No problem, just wear it the following evening.

How long does the lightness from the bleaching last?

It usually lasts from one to three years. In some patients there is no reversal. (They very seldom return to the original discoloration, except for smokers.)

Can I rebleach?

Yes, use the same tray. The product is good for 18 months in the refrigerator.

How fast does rebleaching work?

You will need to rebleach one day for each 5-7 days you originally bleached.

I am pregnant, can I use At-Home whitening agents?

We recommend you not use it until you have completed nursing. (There is no evidence it would harm the newborn, but no studies have conducted to determine if it would harm the offspring. This is an elective procedure so it is better to wait.)

Do I bleach both arches at the same time?

No, first bleach the maxillary arch. (Patients do not sense teeth are lightening if both arches are bleached at the same time.) You will have less chance of TMD discomfort if you bleach one arch at a time.

Is it true that laser bleaching is more effective than at-home bleaching?

No. (The American Dental Association has stated that laser bleaching is not more effective than at-home bleaching.)

How young can you begin bleaching?

Dr. Haywood has bleached patients as young as four when there has been a need for it.

Will it damage my teeth or overall health?

There used to be six agents which were accepted as "safe" and "effective", but now there is only one. If you use that product as recommended, the American Dental Association states it not to harm the teeth or your overall health.

Will it damage my crowns or fillings?

No, it will not damage fillings or crowns. It will not lighten them either. It will discolor some temporary filling materials.

**There is an excellent article on my web site by Dr Haywood entitled "Frequently Asked Questions about Bleaching", which was published in Compendium 24(4A):324-338;2004.**

Figure 1: Mean Delta Shade of Products Evaluated at Clinical Research Section at IU School of Dentistry

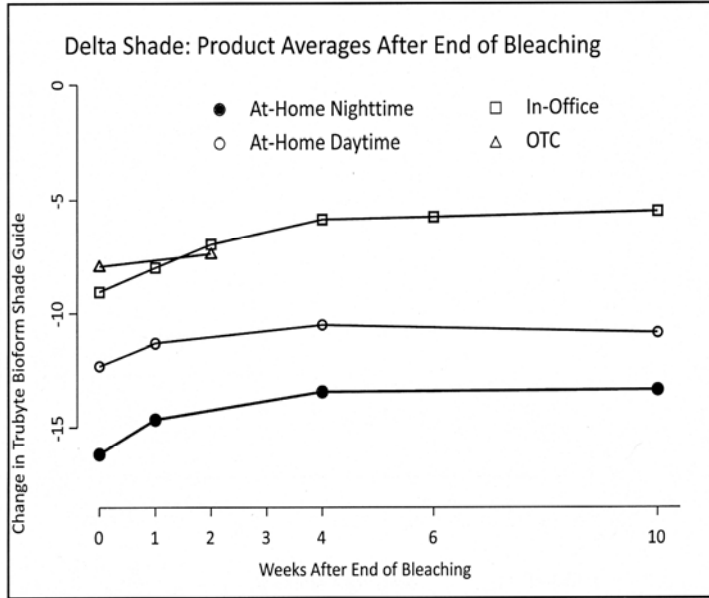
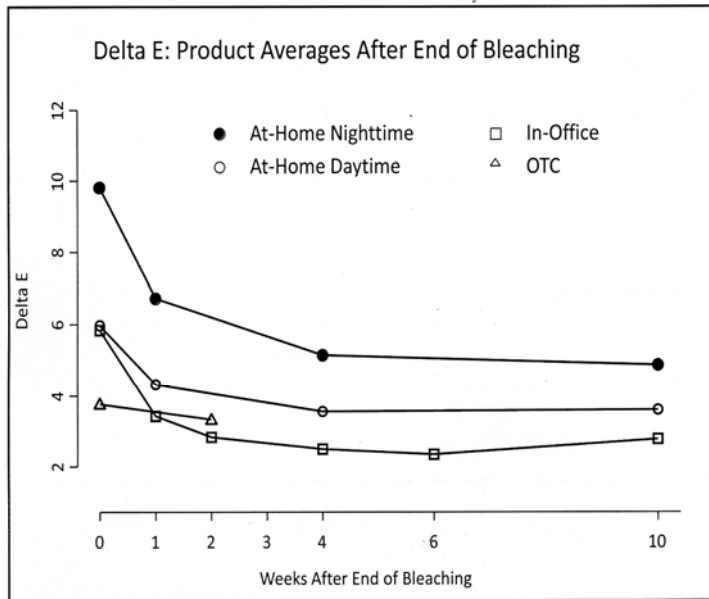


Figure 2: Mean Delta E of Products Evaluated at Clinical Research Section at IU School of Dentistry



**Attachment 1. References to Studies Conducted at  
Clinical Research Section,  
Indiana University School of Dentistry**

**At-Home Bleaching/Professionally Prescribed/Overnight**

1. Matis BA, Cochran MA, Eckert G, Carlson TJ (1998) The efficacy and safety of a 10% carbamide peroxide bleaching gel *Quintessence International* **29(9)** 555-563.
2. Matis BA, Mousa HN, Cochran MA, Eckert GJ (2000) Clinical evaluation of bleaching agents of different concentrations *Quintessence International* **31(5)** 303-310.
3. Matis BA, Cochran MA, Eckert GJ (2007) *In vivo* study of Carbamide peroxide with two different desensitizing agents *Operative Dentistry* **32(6)** 549-556.

**At-Home Bleaching/Professionally Prescribed/Nighttime and In-Office Bleaching**

4. Zekonis R, Matis BA, Cochran MA, Al Shetri SE, Eckert GJ, Carlson TJ (2003) Clinical evaluation of in-office and at-home bleaching treatments *Operative Dentistry* **28(2)** 114-121.

**At-Home Bleaching/Professionally Prescribed/Daytime**

5. Matis BA, Hamdan YS, Cochran MA, Eckert GJ (2002) A clinical evaluation of a bleaching agent used with and without reservoirs *Operative Dentistry* **27(1)** 5-11.
6. Mokhalis GR, Matis BA, Cochran MA, Eckert GJ (2000) A clinical evaluation of carbamide peroxide and hydrogen peroxide whitening agents during daytime use *Journal of the American Dental Association* **131(Sep)** 1269-1277.

**In-Office Bleaching**

7. Shethri SA, Matis BA, Cochran MA, Zekonis R, Stropes M. (2003) A clinical evaluation of two in-office bleaching products *Operative Dentistry* **28(5)** 488-495.
8. Matis BA, Cochran MA, Franco M, Al-Amman W, Eckert GJ, Stropes M (2007) Eight in-office bleaching systems evaluated *in vivo*: A pilot study *Operative Dentistry* **32(4)** 324-329.

**At-Home Bleaching/Over-the-counter**

9. Matis BA, Cochran MA, Wang G, Franco M, Eckert GJ, Carlotti RJ, Bryan C (2005) A clinical evaluation of bleaching using whitening wraps and strips *Operative Dentistry* **30(5)** 588-592.

Attachment 2. Products, concentration, subject number, bleaching, time of bleaching, post bleaching and length of studies.

<u>Study #</u>	<u>Products</u>	<u>Concentration</u>	<u>N</u>	<u>Bleaching</u>	<u>Time of Bleach</u>	<u>Post Bleaching</u>	<u>Length of Study</u>
1	Opalescence	10% CP	30	2 Weeks	Overnight	22 Weeks	24 Weeks
	Placebo	0% CP	30	2 Weeks	Overnight	22 Weeks	24 Weeks
2	Opalescence	10% CP	25	2 Weeks	Overnight	4 Weeks	6 Weeks
	Opalescence	15% CP	25	2 Weeks	Overnight	4 Weeks	6 Weeks
3	Opalescence	15% CP + PF	32	2 Weeks	Overnight	10 Weeks	12 Weeks
	Nite White	16% CP +ACP	32	2 Weeks	Overnight	10 Weeks	12 Weeks
4	Opalescence	10% CP	20	2 Weeks	Overnight	10 Weeks	12 Weeks
	StarBrite	35% HP	20	2 Weeks	2-3X10 Min	10 Weeks	12 Weeks
5	Rembrandt Xtra	15% CP	27	2 Weeks	2 Hours	10 Weeks	12 Weeks
	Rembrandt Xtra	15% CP	27	2 Weeks	2 Hours	10 Weeks	12 Weeks
6	Opalescence	20% CP	24	2 Weeks	2X60 Min	10 Weeks	12 Weeks
	Day White	7.5% HP	24	2 Weeks	2X60 Min	10 Weeks	12 Weeks
7	Opalescence Xtra B	35% HP	20	1 Hour	In chair	11 Weeks	11 Weeks
	Opalescence Xtra B	38% HP	20	1 Hour	In chair	11 Weeks	11 Weeks
8	Accelerated	40% HP	4	15 Min	In chair	6 Weeks	6 Weeks
	ArcBrite	30% HP	4	1 Hour	In chair	6 Weeks	6 Weeks
	BriteSmile	15% HP	4	1 Hour	In chair	6 Weeks	6 Weeks
	Illumine	15% HP	4	1 Hour	In chair	6 Weeks	6 Weeks
	Niveous	27% HP	4	45 Min	In chair	6 Weeks	6 Weeks
	One-Hour Smile	35% HP	4	45 Min	In chair	6 Weeks	6 Weeks
	PolaOffice	35% HP	4	36 Min	In chair	6 Weeks	6 Weeks
	Zoom!	25% HP	4	1 Hour	In chair	6 Weeks	6 Weeks
9	Whitestrip Supreme	10% HP	25	1 Week	2X30 Min	2 Weeks	3 Weeks
	Ranir Wrap	8% HP	26	1 Week	2X30 Min	2 Weeks	3 Weeks
	Ranir Wrap	8% HP	25	1 Week	30 Min	2 Weeks	3 Weeks