Evidence Based Tooth Whitening*

Dr. Bruce A. Matis
www.bamatis.com
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Part 1 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".
-Bleaching works, but how do we present it?
-To promote bleaching have posters, offer staff bleach and discuss color at restorative appointment. Ask "How do you like your teeth?"
-Listen, evaluate, discus bleaching with patients. Beware of patients with unrealistic expectations.
-To determine if patients have bleached, check out color of cuspids. If same as incisors, patient has probably bleached.
-"Patients and consumers now demand not only a healthy mouth but also a perfect smile."
Joiner, J Dent 32(Sup 1):3-12;2004
-"Tooth shade is indeed the most important variable of the attractiveness of a smile."
Dunn et al., J Prosthod 5:166-171;1996
-As we age our teeth become darker, more yellow and slightly more red.
Odioso, Compendium 21:S35-S41;2000.

Goal is to remove stain
-Extrinsic—Stain, which is deposited on the outside surface.
Whiteners will lighten calculus and the subsurface structure.
-Intrinsic—Stain, which is incorporated into the tooth structure before or after eruption.
Tooth whiteners penetrate tooth surface to affect the color.

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 meds that make them sensitive to light, possible "burning" of tissues.
-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 Corp	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-year recall shows that light use does not increase whitening over non-light use.
CRA Newsletter 28(6):1-2;2004

-The effect of intrapulpal temperature rise on vitality of pulp in Rhesus monkies.
Zach & Cohen, O Surg, O Med, O Path 19:515-530;1965

-Effects of In-office tooth whiteners on <u>hardness</u> and <u>surface finish</u> of tooth colored restoratives.
Both are material dependent and minimally affected by bleaching agents.
*Yap et al. Op Dent 27:137-141;2002
*Wattanapayungkul et al. Op Dent 28:15;2003

-No effect on enamel micromorphology when 38% HP used in an *in vivo* study on teeth.
Cadenaro et al., Op Dent (accepted for publication)

-ADA accepted In-office product is not as effective as ADA accepted At-home product.
*Zekonis et al. Op Dent 28:114-121;2003

-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) Tooth shade is the most important element of patients' perception of dental attractiveness.
2) When patients come in, Listen, Evaluate and Discus bleaching with patient to make sure you can meet their expectations.
3) Main purpose of whitening agents is to remove intrinsic staining.
4) Isolation of soft tissues is a must with In-office bleaching.
5) Tooth lightness and color reversal are person dependent.
6) Light activation does not appear to increase tooth lightening effect of bleaching.
7) Excessive length of light on one tooth can cause injury to the pulp.
8) High concentrations of peroxide do not affect <u>hardness</u> or <u>surface finish</u> of dental materials, hardness and surface finish are material specific.
9) At-home is more effective than In-office bleaching using ADA accepted products.
10) Follow In-office bleaching with use of At-home tray whitening gel.

Part 2 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

-There appears to be an "inherent lightness potential" of teeth.

-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

-The following products are accepted as safe and effective by the ADA.
Opalescence Whitening Gel **10% CP**
Platinum Daytime Professional Whitening System **10% CP**
http://www.ada.org/ada/seal/adaseal_consumer_shopping.pdf, October 2007

-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

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. No difference between 10% and 15% four weeks post-bleaching.
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. 20% CP or 7.5% used 1 hr twice daily produces same lightness as 10% CP overnight.
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
-Minor 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
-Sodium Lauryl Sulfate may cause gingival irritation or apthous ulcers, when toothpaste is used.
-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.

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

Effects on teeth
-Study *in vivo* completed recently showed no changes in microhardness and shear bond strength returned to baseline values in two weeks.
*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.

Degradation

-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 are a combination of 1) absorbent tooth (13%), 2) physical loss of agent, 3) anti-oxidant degradation, 4) Increased temperature 5) product degradation
*Matis, Compendium 24(SI4A):354-362;2003

-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. Usually two weeks (but I have bleached yellow teeth for two months).

-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.

-How long does tooth whitening last?
Leonard et al., J Esthet Rest Dent 15:142-152;2003

Over the counter tooth whitening agents

-Tooth pastes 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

-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

-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 3 products. All have 10% CP.

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

-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

Comparison of studies is very difficult. Different criteria, instruments and personnel are used. At IUSD we have completed 12 studies, most of which are published or will soon be published. The At-home gels are used for two weeks in all studies reported.

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) 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.
5) Trays need to be made carefully so they fit well.
6) Show patients how to use product so they do not waste or ingest bleaching agent.
7) 10% CP has been shown histologically to cause some minor but reversible changes in the pulp.
8) Tooth sensitivity can be reduced by using potassium nitrate, reducing frequency of bleaching or bleaching for shorter periods during the daytime.
9) Tissue sensitivity can be reduced by trimming the tray length and/or removing the product from off the tissues.
10) Caries susceptibility decreases with PF and stays the same even with 35% HP
11) Microhardness stays the same after bleaching.
12) Shear bond strength is reduced with bleaching, but returns to baseline in 2 weeks postbleaching.
13) Resin restorations should not be placed for up to two weeks post-bleaching.
14) Restorative materials do not degrade during bleaching.
15) 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.
16) Patients will ingest 50% more peroxide when trays are used without reservoirs.
17) Not a lot of active agent is used during the bleaching process.
18) Reservoirs are needed for overnight bleaching.
19) After 20 minutes about 50% of the initial active hydrogen peroxide is remaining in trays.
20) Systems from most to least effective: At-home nighttime, At-home daytime, In-office, Over-the-counter.

Part 3 Clinical Cases: The Test is in the Taste

1) 4 year old who fell down, traumatizing deciduous central incisors, which were bleached for a total of 47 hours.

2) 19-year-old male, endodontically treated #8, 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 #8, 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 #9 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 left central incisor 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.

Stubborn stains

-Remove fluoride staining, a post eruptive stain in enamel, three ways:
-Beaching, microabrasion with HCl acid, and/or use bur to remove stain
Croll, J Am Dent Assoc 128:S45-S50;1997
-Remove tetracycline staining, a pre-eruptive stain in dentin, usually with bleaching
-Professionally rated esthetical results of six months treatment of tetracycline staining:
Matis et al., Quint Int 33:645-655;2002

Summary and Conclusions

1) Teeth can be lightened to match a crown that has been placed previously, many years ago.
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 orifice with glass ionomer as resin will not adhere well 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) Use bleach as long as teeth continue to lighten.
8) Teeth will rebleach 5 times faster than they initially bleach.
9) Staining depends on stain quotient of patients. Usually lasts 6 months to 3 years.
10) Bleaching usually removes fluorosis and it does not return.
11) Some teeth with tetracycline staining may take longer than six months to lighten, especially in the cervical area.
12) More than 50% of the tooth lightening in fluorosis cases occurred did so in the first month.
13) Significantly more subjects had sensitivity in the study on bleaching with tetracycline on the sides using 15% and 20%.

End of Course Thank you for your attention

* Articles are available on Dr Matis' web site- 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 are three agents, which have been accepted as “safe” and “effective”. If you use any of those products as recommended, they have been shown 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 Evalutated at Clinical Research Section at IU School of Dentistry

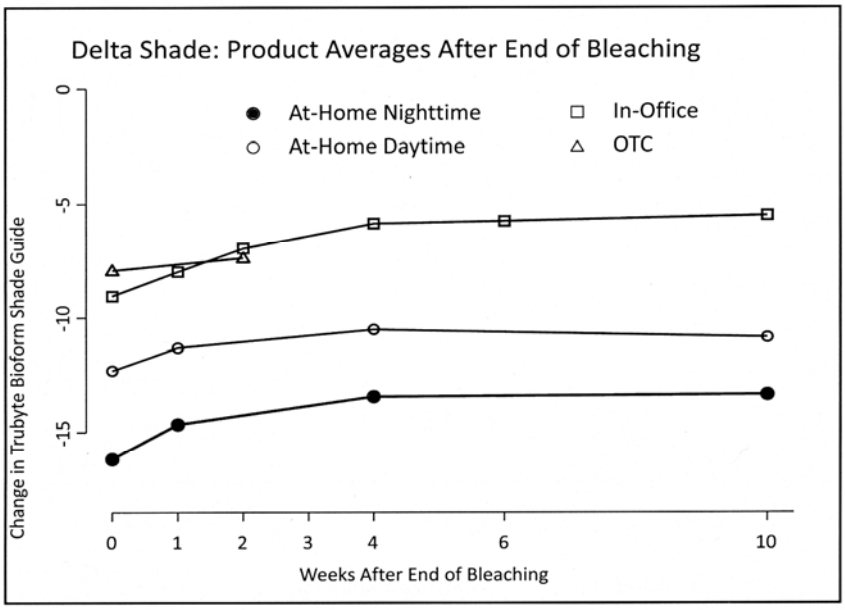
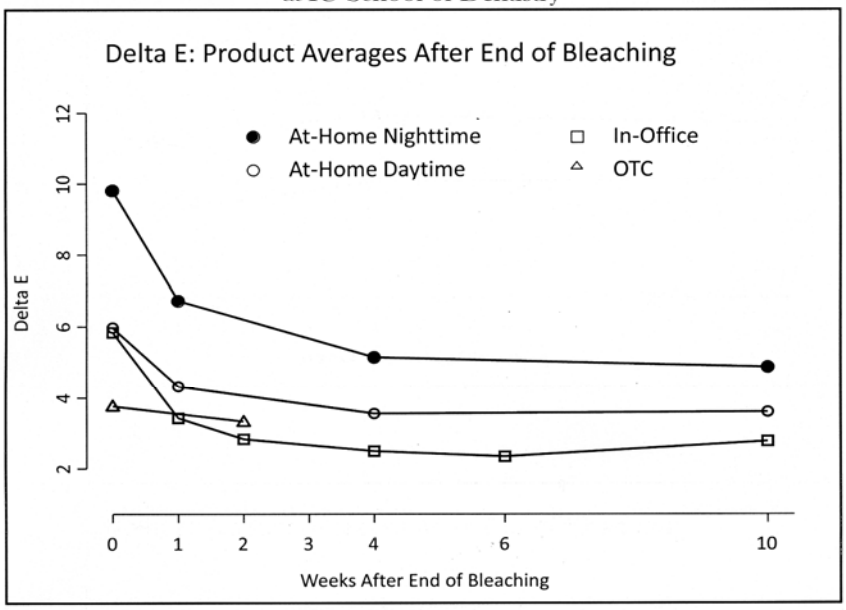


Figure 2: Mean Delta E of Products Evalutated at Clinical Research Section at IU School of Dentistry



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/Nightime 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. Panich M (1999) *In vivo* evaluation of 15-percent carbamide peroxide and 5.5-percent hydrogen peroxide whitening agent during daytime use [Thesis] Indianapolis, IN: Indiana University, School of Dentistry.

6. 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.

7. 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

8. 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.

9. Matis BA, Cochran MA, Franco M, Al-Ammar 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

10. 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.

Study #	Products	Concentration	N	Bleaching	Time of Bleach	Post Bleaching	Length of Study
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	Opalescence	15% CP	25	2 Weeks	2X30 Min	4 Weeks	6 Weeks
	Day White	5.5% HP	25	2 Weeks	2X30 Min	4 Weeks	6 Weeks
6	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
7	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
8	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
9	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
10	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