

Evidence Based Tooth Whitening

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The objective of this presentation is to increase your understanding of tooth whitening. We will do this by reviewing mostly clinical studies in the scientific literature that have been published. The presentation has been divided into eight sections. They are:

Introduction	Tooth concerns
Evaluation of color	Pulpal concerns
Systems used in Tooth Whitening	Effectiveness of systems
Material concerns	Clinical Cases

Introduction

- There are three main types of dental research studies
 - In Vitro- a laboratory bench study
 - In Situ- an in mouth, but not always in the mouth study
 - In Vivo- an in the mouth during treatment study
 - All except three studies in this presentation are In Vivo studies
 - You can count on finding in your practices the findings of In Vivo studies
- Why learn about tooth whitening?
 - Restorative Dentistry is changing. “The more we cut tooth, the more we weaken tooth.”
- How do we present it to our patients without insulting them?
 - To promote bleaching have posters, offer staff bleach or discuss color at treatment planning appointment. Ask “How do you like your smile?” or “Are you pleased with the color of your teeth”.
 - Listen, evaluate, discuss bleaching with patients. Beware of patients with unrealistic expectations.
- How important is tooth whitening to our patients?
 - 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.
- How does tooth whitening work?
 - Color is determined by the light source and the ability of a surface to absorb and reflect light waves.
Chu, Devisus et al., Fundamentals of Color: Shade Matching and Communication in Esthetic Dentistry, 2010 p11, Quintessence Publishing Co, Hanover IL
- What are the two kinds of stains that develop?
 - 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.
- What agent/s lighten teeth?
 - Peroxide is active agent. Found in Carbamide Peroxide. Breakdown:
10% CP=3% HP+7% Urea; HP=Oxygen + Water; Urea=Ammonia + Carbon Dioxide
Lazarchik, Haywood, JADA 141:639-646;2010

Evaluation of Color

- How is color evaluated in the scientific literature?
 - Tooth color should be evaluated both subjectively and objectively.
 - Subjectively shade guides are used.
 - Objectively a colorimeter or spectrophotometer is used to measure L*, a*, b* and Delta E.

Systems Used in Tooth Whitening

- “Patients and consumers now demand not only a healthy mouth but also a perfect smile.”
Joiner, J Dent 32:3-12;2004
- How many systems are there for whitening teeth?
 - There are six major systems, three are At-home systems and three are In-office system.
- What are the advantages and disadvantages of each system?
 - At-home custom tray bleaching
 - Advantages-Lower tooth sensitivity, more effective, less peroxide ingested (with reservoirs)
 - Disadvantages-Not predictable, takes longer.
(See Tray Making and Delivery Series on web site under “Home”)
 - At-home Over-the-counter bleaching
 - Advantages-Less expensive, no doctor visits
 - Disadvantages-Not as effective, higher concentration than recommended
 - There are four major types of over the counter products; Strips, Wraps, Tray-in-Tray and Paint-On
 - In-office bleaching-outside surface (Sometimes called “Power Bleaching”)
 - Conventional
 - 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
 - In-office outside layer (Sometimes called “Microabrasion”)
 - Advantages- No gel ingested, no tooth sensitivity, accomplished in one setting
 - Disadvantages-Must use rubber dam, demineralizes 8-22 microns, only works on superficial stains
 - In-office bleaching-inside the pulp chamber (Sometimes called “Walking Bleaching”)
 - Advantages-No gel ingested, no tooth sensitivity
 - Disadvantages- Need to see patient multiple times, difficult to seal lingual, requires entry into pulp chamber and a barrier placed.
 - Has caused iodopathic root resorption when barrier not placed.

Material Considerations –Concentrations for At-home Use

- What concentration to use for At-home tooth bleaching
 - The higher the concentration, the more rapid the tooth whitening.
Harris et al., JRD 80:172 Abst 1096; 2001.

- American Dental Association's Seal indicates a material is "Safe" and "Effective"?
 - 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 4/11/11
- How long is the carbamide peroxide bleaching material active?
 - Determined by ability to recover agent after it is placed.
 - 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
- Does hydrogen peroxide degrade at the same rate as carbamide peroxide?
 - HP degrades more rapidly than carbamide 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
- Bleaching is polydirectional
 - Area under orthodontic brackets is lightened when bleaching.
Jadad, Am J Orthod Dentofacial Orthop 140:e43;2011
- Accuracy of concentration on label
 - Product label concerns may be in manufacturing process, or could occur during shipment and storage in the US and other countries. Products tested using method advocated in US Pharmacopia for carbamide peroxide.
 - In United States 35 products within 30% of concentration indicated on label
 - In China 13 products tested within 30% of concentration indicated on label
 - In Saudi Arabia 1 of 8 products had greater than 30% difference in concentration than indicated on label
 - In Brazil 3 of 15 products had greater than 30% difference in concentration than indicated on label
 - *Matis et al., Op Dent 38(3):334-343;2013

Tooth Concerns

- In dental procedures there are "Benefits" and "Risks"
- Is there loss of adhesion in enamel with resin composites after bleaching?
 - 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
 - The reason is "oxygen inhibition" that occurs with Bis-GMA resins.
 - Why not place resin immediately after bleaching?
Cannot bond properly because of oxygen inhibition internally.
Cannot color match because color reversal will occur.

- Is there a loss of enamel microhardness?
 - Study in vivo shows no changes in microhardness after bleaching for two weeks.
 - *Metz et al., Op Dent 32(5) 427:2007
- Are there morphological changes on tooth surface?
 - Effect on enamel micromorphology when 38% HP or 35% CP were used in an *in vivo* study on teeth.
 - Cadenaro et al., Op Dent 33(2):127-134;2008
- Is there an increase in caries susceptibility?
 - Use of PF will make tooth more resistant to caries.
 - *Al-Qunaian, Op Dent 30:265;2005

Pulpal Concerns

- Does peroxide placed on the tooth during treatment cause histological changes to the pulp?
 - 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. Op Dent 29:363-368;2004
- What else can be done to reduce tooth and tissue sensitivity?
 - Tooth sensitivity
 - Use of 10% CP for shorter time periods can decrease tooth sensitivity.
 - Cardoso et al. J Am Dent Assoc 141:1213-1220;2010
 - Ask patients about sensitivity to cold water when they brush their teeth. If sensitive to cold water, have them start brushing with potassium nitrate containing toothpaste 2-3 weeks before bleaching.
 - Potassium nitrate gel faster acting than toothpaste.
 - Haywood, Dental Products 43:82;2000
 - Sodium Lauryl Sulfate in toothpaste may cause gingival irritation and aphthous ulceration. Potassium nitrate alone does not cause tissue sensitivity.
 - Tissue sensitivity does it occur?
 - It does occur, but not very often.
 - Matis et al., Quint Int 29:555;1998
 - To reduce tissue sensitivity, have patient more effectively remove excess bleaching agent that comes out of the tray and trim tray shy of cervical collar of gingiva.

Effectiveness of various concentrations and systems

- How effective are the In-office systems?
 - In-office bleaching outside tooth surface, Conventional (Power Bleaching)
 - 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 SDI Industries
One Hour Smile by Den-Mat	Zoom! by Discus Dental

 - *Matis et al., Op Dent 28:324;2007

---Light use did not improve the effectiveness of the In-office conventional system
Effectiveness evaluated with and without use of light.
Opalescence Xtra Boost PolaOffice Rembrandt Lighten Plus
LumaArch Niveous LaserSmile
Zoom!

CRA Newsletter 27(3):3;2003

---Light does not enhance tooth bleaching and may pose a health risk especially those with ultraviolet light.

Bruzell, et al. Photochem and Photobio Sci., 8:377;2009

--In-office bleaching outside tooth surface (Microabrasion)

---Microabrasion is effective on superficial enamel defects

Benbachiretal et al., Quint Int 38;811-815;2007

--In office bleaching inside tooth chamber (Walking Bleach)

---Sodium perborate can be mixed with water as well as peroxide with equal effectiveness.

de Souza-Zaroni et al., Oral Surg, Oral Med, Oral Path, Radoil, Endod
107:e43-e47;2009

-How effective are the At-home systems used with a custom tray?

--All studies had at least **24 subjects**, bleached for **14 days** and **used reservoirs** in trays.

Maxillary anterior teeth evaluated for color **objectively** and **subjectively**.

--Not everyone lightened as they had hoped as evidenced by evaluation of clinical photographs. Reversal of color came to a plateau between two weeks and one month postbleaching. Efficacy of 10% CP used for two weeks shows 17% large change, 48% moderate, 21% slight and 14% none after six months.

Matis et al., Quint Int 29:555;1998

--There are three other half-mouth design studies which taught us some important concepts.

---10% CP and 15% CP, overnight. 15% was no different than 10% at the end of one month

Matis et al., Quint Int 31:303-310;2000

---15% CP and 5.5% HP, ½ hour 2X daily showed equal concentrations produced equal results.

Panich, Masters Thesis, IUSD, 1999

---20% CP and 7.5% HP, 1 hour 2X daily showed 20% twice a day was no better than 10% overnight.

Mokhlis et al., J Am Dent Assoc 131:1269-1277;2000

--We can now compare the In-office with three studies using 10% CP overnight in trays with reservoirs. 10% was twice as effective both subjectively and objectively than In-office products.

-How effective are the Over-the-counter systems?

--Whitening gels found over-the-counter

---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

-Is there one comparison of all the systems effectiveness?

--Nine studies with 26 products with both subjective and objective evaluations

At-home nighttime in tray with reservoir is most effective system

At-home daytime in tray is next most effective system

Over-the-counter is next most effective system

In-office systems is the least effective system

*Matis et al., Op Dent 34:230-235;2009

Odds and Ends

- How long do patients use agent?
 - When cuspids become as light as central and lateral incisors, I advise patients to stop bleaching.
- Do I deliver both trays at the same time?
 - Deliver maxillary tray first so patients can see the amount of bleaching that has occurred.
- Rebleaching, how often should it be done?
 - When needed, probably every one to three years.
- Does rebleaching take as long as initial bleaching?
 - No it is much faster, one day of rebleaching is usually required for every 5-7 days of initial bleaching.
- Can we guarantee lightness with bleaching?
 - No, but I tell patients I will apply the money it costs to bleach on a discount for veneers or crowns within three months if they are not pleased with the results.
- How long does tooth whitening last?
 - 42% were satisfied after 10 years post bleaching
Leonard et al., J Esthet Rest Dent 15:142-152;2003
- Can teeth underneath veneers be whitened?
 - It will go around and underneath a resin. Before replacing veneers due to darkened color, bleach from inside.
Haywood, et al. Quint Int 30:743;1999
- Is the use of hydrogen peroxide or carbamide peroxide safe?
 - “All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy.”
Paracelsus (1493-1541)
- Are there other excellent sources of information on tooth whitening?
 - Excellent article entitled “Biological Properties of Peroxide-containing Tooth Whiteners”.
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
 - Book entitled “Tooth Whitening: Indications and Outcomes of Nightguard Vital Bleaching”
Van Haywood, Published by Quintessence International

Clinical Cases

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.

36-year-old female, trauma caused discoloration of tooth N 11, no periapical pathology, bleached 6 weeks. Followed for 4 months post-bleaching

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.

62-year-old female bleached mandibular teeth 6 weeks. Followed for 2 months post-bleaching.

Lightened stained craze line on N 21 on 66-year-old female. Followed for 4 months post-bleaching. Cervical dentin does not usually lighten much with bleaching.

Hypocalcified area was bleached for 14 days, white spot lightened rapidly then returned to original color after cessation of bleaching.

Unhappy person who was dissatisfied with vital bleaching and decided on veneers.

Fluoride stain removal using bleaching on a 28 year old.

Tetracycline stain removal in a study accomplished in the Peoples Republic of China

--Cervical area stain most challenging to remove,

*Matis et al., Op Dent 31(6):643-651;2006

Never promise results but help patients understand the possibilities!

* Articles are available on Dr Matis' web site- www.bamatis.com

Other 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.

Can I rebleach?

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

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.)

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.