Evidence Based Tooth Whitening

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The objective of this presentation is to increase your understanding of tooth whitening. The presentation has been divided into eight sections. They are:

Introduction	Tooth concerns
Material concerns	Effectiveness of systems
Pulpal concerns	Clinical Cases

Introduction

-Why learn about tooth whitening?
--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".
-How important is tooth whitening to our patients?
--"Patients and consumers now demand not only a healthy mouth, but also a perfect smile."
Joiner, J of Den 2004;32:3-12
-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+ Urea; HP=Oxygen + Water; Urea=Ammonia + Carbon Dioxide
--Other agents that are used in tooth whitening: Chlorine Dioxide 0.004%; Perchlorate, Sodium Perborate
-Three kinds of dental research studies
--*In Vitro*- Lab bench studies
--*In Situ*- In mouth, some of the time
-- *In Vivo*- In mouth during treatment
-Bleaching is polydirectional, the lingual will lighten even though we do not bleach it.
--Orthodontists can even bleach with brackets in place but not with clear aligner treatment.
Jadad et al., Am J Orthod Dentofacial Orthop 2011;2011:e43

Material Concerns

-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
-Causes of loss of recoverable agent: whitening/absorbent tooth (13%); physical loss if no reservoir (14%), anti-oxidant degradation/increased temperature/product degradation (31%)
*Matis, Compendium 24(SI4A):354-362;2003

-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

Pulpal Concerns

-Does peroxide placed on the tooth during 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 (Fugaro), J. Masters Thesis IUSD 2002
-Will discomfort occur during tooth whitening?
--Patient may have one of two different kinds of discomfort: Tooth or Gingival 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
-What can be done to reduce tooth and tissue sensitivity?
--Tooth sensitivity
---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 before bleaching.
---Use of 10% CP for shorter time periods can decrease tooth sensitivity.
Cardoso et al. J Am Dent Assoc 141:1213-1220;2010
---Potassium nitrate gel faster acting than toothpaste.
Haywood, Dental Products 43;82:2000
--Tissue 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.

Tooth Concerns

-Is there a loss of microhardness?
--Studies differ in loss of microhardness. Some good studies show loss of microhardness and changes in micromorphology, some show none.
Attin et al. J Dent Mat 25:143;2009
--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 used in an *in vivo* study on teeth. Conclusion of study: There is no morphological loss of tooth structure…."
Cadenaro et al., Op Dent 33(2):127-134;2008

-Morphological tooth loss is much different than enamel microhardness
--Pilot Study at Therametric Technologies with 35% phosphoric acid
---*In Vitro* 2 minutes; microhardness loss and enamel height loss
----Baseline VHN=359.8; Post treatment VHN=287.5; Difference 20.1
----Average height loss 11.8um; Maximum height loss 20.5um
-There are *In Vitro* and *In Situ* studies showing a loss of enamel microhardness. How can that be?
--Pilot Study at Therametric Technologies, Inc. Used Vickers Hardness Number (VHN)
---*In Vitro* 14 days bleaching with 10% CP and 14 days no treatment
----Baseline VHN=338.0; Not cleaned VHN= 307.0; Difference -9.17%
----Baseline VHN=338.0; Cleaned VHN= 334.0; Difference -1.18%
---*In Situ* 14 days bleaching with 10% CP and 14 days no treatment
----Baseline VHN=329.3; Not cleaned VHN= 302.3; Difference -8.20%
----Baseline VHN=329.3; Cleaned VHN= 326.3; Difference -0.91%
-A change in enamel microhardness can be caused from buildup of pellicle and crystalline structure on the surface of the enamel.
-Is there loss of adhesion 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
--Why not place resin immediately after bleaching?
Cannot bond properly because of oxygen inhibition internally.
Cannot color match because color reversal will occur.
--The reason is "oxygen inhibition" that occurs with Bis-GMA resins.

Effectiveness of various concentrations and systems

-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 calculating L*, a*, b* and Delta E.
-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.
Matis et al., Quint Int 29:555;1998
--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
--Here 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

-How effective are the In-office systems?

--*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

--Does light use improve the effectiveness of the In-office systems?

---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

--At-home systems will boost in-office systems

*Matis et al. Op Dent 34;142-149;2009

--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.

-Summary of 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.

-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 a patient over bleach—if so, when do you stop bleaching?

--We cannot conduct studies to determine this as the first principle if research is "Do no harm". Therefore, when cuspids become as light as the central and lateral incisors I tell patients it is time to stop bleaching.

-Are there any contraindications to bleaching?

--The contraindications to bleaching are patients with resin or peroxide allergies and pregnant or lactating women.

-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 any contraindications for tooth whitening?

-- Patients with resin allergies, peroxide allergies and pregnant or lactating patients.

-How old should patients be before bleaching?

--Should not lighten teeth while patient is in mixed dentition.

--Tooth whitening for individual teeth has a different policy.

Ped Dent 30(7 Sup):61-63;2008

Clinical Cases

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

83-year old male who bleached for 6 weeks came in for one-month postbleaching photo

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

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

--Not all tetracycline staining can be bleached

--Cervical area stain removal most challenging to remove

--Clinical cases of Bleaching Tetracycline Stained Teeth

*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