In Vivo Pilot Study: Effect of Dehydration/Rehydration on Upper Anterior Tooth Color Change

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INTRODUCTION

Isolation of tooth structure during fabrication of a bonded, direct, resin-based restoration is essential to optimizing its potential for long-term clinical success. Failure to protect etched enamel and bonding agents from contamination by saliva results in inadequate and unpredictable interfacial bonding of the restorative composite, potentially leading to marginal discoloration, open margins, recurrent decay, or ultimately to restoration loss or failure.

A consequence of tooth isolation during placement of direct, esthetic restorative resins is the dehydration of enamel surfaces that will not be coated with saliva, and will, over time, lose water that has penetrated into the outer enamel layers (will dehydrate). The longer the tooth isolation time, the greater will be the subsequent loss of water from enamel. Presence of this water in enamel helps to provide for a stable tooth color. In teeth, the observed tooth color is the result of internal light penetration and interaction with tissues below the surface. Enamel is a translucent material, passing a great majority of transmitted light to fall on the more opaque and yellow-colored tissue underneath of it: dentin. In the hydrated state, enamel is more translucent than in its dehydrated state. The white opaque appearance of dehydrated enamel can be of great clinical concern, once a rubber dam has been removed, and the treated teeth with newly placed restorations are observed.

"natural" enamel color of hydrated enamel (not protected by rubber dam)

Lightened enamel color from rubber dam isolation

https://www.nature.com/vital/journal/v10/n1/fig_tab/vital1606_F11.html

Usually, because of the opaque, white nature of recently dehydrated enamel, there is an initial mismatch between an esthetic restoration just placed and its surrounding, remaining enamel. Patients are normally forwarded of this consequence, and are advised that a period of time needs to pass before the surrounding enamel becomes rehydrated, and more translucent (less opaque), before its pre-isolated color returns to a natural state. It is hoped that, at that time, the new restoration will perfectly match the color characteristics of the remaining enamel, and the recent replacement will not be visible at all, but will instead optically blend in without notice. However, prior to that time, there are definitely distinct color differences between a recently placed resin restoration and its surrounding tooth structure. To date, little-to-no information is available on the rate at which a clinician or patient can expect isolated enamel to return to its pre-isolated color, and when to expect this esthetic blending to occur.

METHODS

METHOD OF INSTRUMENT STABILITY

VITA Easyshade 4.0

CUSTOM MATRIX TO HOLD PROBE

Tooth color parameters recorded

L a b

L = Light vs. dark where a low number (0-50) indicates dark and a high number (51-100) indicates light

a = Red vs. green where a positive number indicates red and a negative number indicates green

b = yellow vs. blue where a positive number indicates yellow and a negative number indicates blue.

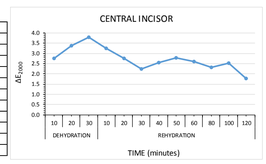
COLOR SPACE INFORMATION PLACED INTO CUSTOM SPREAD SHEET FILE

SPREADSHEET SOFTWARE

DATA ENTERED HERE

CENTRAL INCISOR

CONDITION	TIME (min)	ΔE_{2000}	RATING
DEHYDRATION	10	2.8	VUA
	20	3.4	VUA
	30	3.8	VUA
REHYDRATION	10	3.2	VUA
	20	2.8	VUA
	30	2.2	VUA
	40	2.5	VUA
	50	2.8	VUA
	60	2.6	VUA
	80	2.3	VUA
	100	2.5	VUA
	120	1.8	VA



COLOR CHANGE ($\Delta E2000$)

RELATIVE TO BASELINE VALUES:

if $\Delta E_{2000} < 0.8$ Change is Not Visually Perceptible (NVP)

if $\Delta E_{2000} > 0.8$ but < 1.8 Change is Visually Acceptable (VA)

if $\Delta E_{2000} > 1.8$ Change is Visually UnAcceptable (VUA)

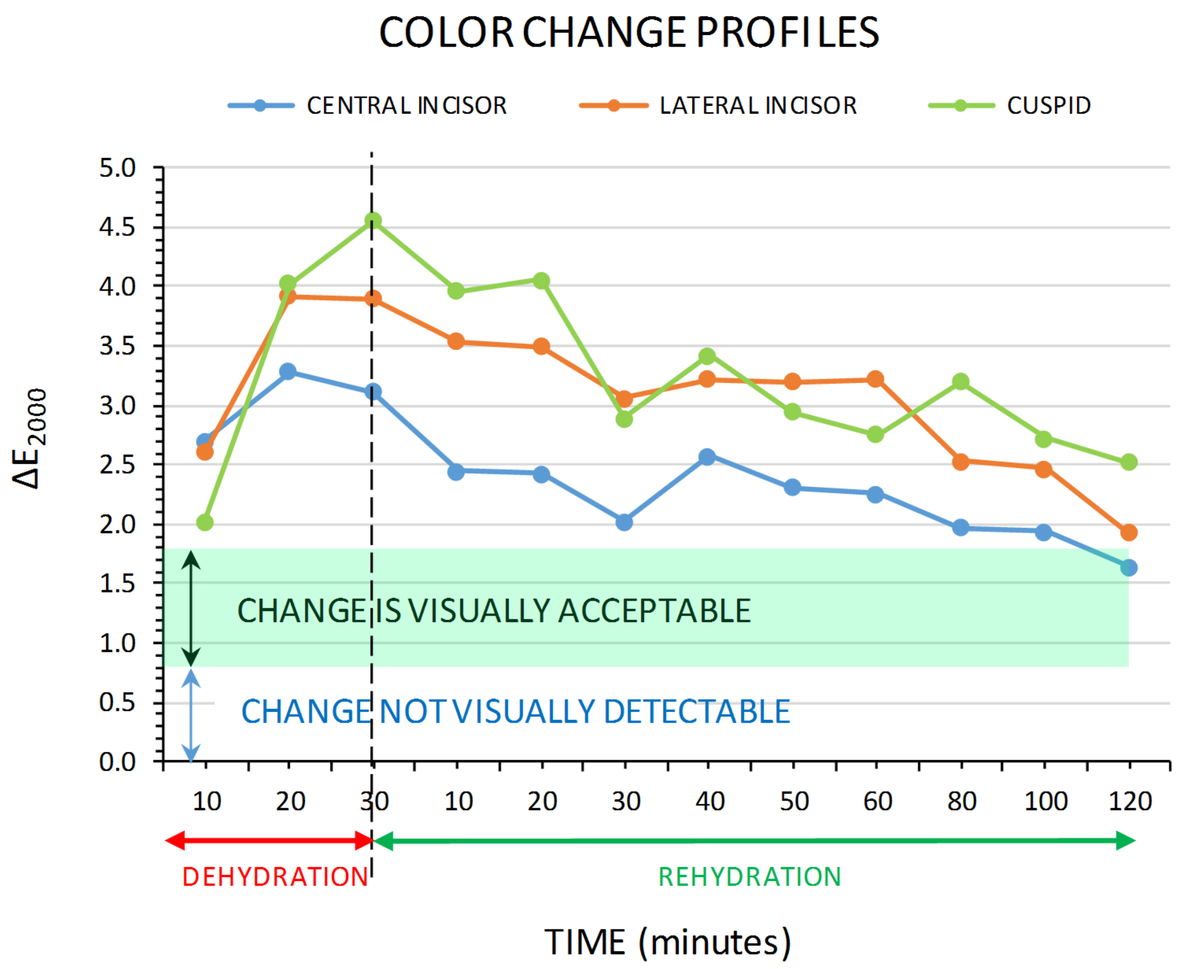
PURPOSE

The purposes of this *in vivo* pilot test were to (1) develop a testing protocol whereby repeatable measurement of intraoral tooth color data would be obtained in order to (2) evaluate the extent of color change upon isolation and subsequent return to pre-isolated color values following rehydration of upper anterior teeth.

HYPOTHESES

1. Use of a custom-made intraoral positioning device will greatly reduce variation in measured tooth color values over the time of isolation and rehydration as opposed to hand-held instrument data acquisition, and
2. The rate of tooth color change and rehydration is correlated with tooth mass, with the cuspid changing the least and slowest, the lateral incisor changing the most and fastest, and the central incisor showing values between these two extremes, and
3. After 30 minutes of isolation and 90 minutes of rehydration, the color parameters of all isolated teeth will return to their original, pre-isolation values.

RESULTS



Use of custom positioning matrix greatly reduced color parameter measurement over that when hand-holding alone (data not shown)

Data shown is from two separate clinical trials (a total of 4 trials made) where trends in observed data were what was expected.

Based on the results observed:

1. Extent of color change from baseline, pre-isolated values increase with extent of duration in isolation time
2. After 30 minutes isolation, color change in cuspid > lateral > central incisor
3. Extent of dehydration change lessens as teeth become rehydrated over time
4. Even after 1.5 hours of rehydration, change in tooth color was still above the visually detectable level, relative to baseline, pre-isolation values

CONCLUSIONS

1. Use of custom matrix greatly reduced recordings of color change values (data not shown),
2. A definite trend of color change in all teeth isolated for 30 minutes seen,
3. A clear, slow trend, in tooth color returning to baseline levels was observed for all tested teeth, and
4. Improvements in testing protocol need to be made in order to provide greater reproducibility in order to provide valid measurement of the potential for tooth color change from dehydration / rehydration