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Role of hydrogen peroxide mouth rinse in reducing discoloration of various esthetic ligation methods used in orthodontics - an in vivo study

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Abstract

Aim: Hydrogen peroxide mouth-rinse (1.5%) had been studied as an agent in this study to evaluate the reduction in discoloration of esthetic ligation methods after intra-oral exposure and also to observe their effect on periodontium.

Material and Method: In 30 patients undergoing orthodontic treatment, split-mouth design was employed for clear elastomeric modules and Teflon coated ligature wire, wherein AO was placed in the first quadrant, 3M in second quadrant, Teflon in the third quadrant and TP in the fourth quadrant. They were tested at three different time period: As received state, after 3 weeks of intra oral exposure and after 3 weeks of intra oral exposure with hydrogen peroxide mouthwash twice daily. Their change in color dimensions were observed through digital SLR camera.

Result: After intra oral exposure of 21 days, ΔE (change in color) for first quadrant is 51.30±0.43, for second quadrant is 47.24±0.82, for third quadrant is 3.77±0.32, for fourth quadrant is 43.24±0.57. After intraoral exposure of 21 days with Hydrogen peroxide mouthwash, ΔE observed for First Quadrant is -14.48±0.43, for Second Quadrant is -11.64±0.23, for Third Quadrant is ΔE= -2.30±0.40 and for Fourth Quadrant is -16.89±0.82.

Conclusion: Within the limitations of the study, it was concluded that hydrogen peroxide revealed statistically significant potential in reducing discoloration as well as gingival inflammation. Also, Teflon coated ligature wire had shown most superior properties in terms of resistance to discoloration. So, it can be the preferred choice for aesthetic ligation.

Keywords: Hydrogen Peroxide, Esthetic ligation, Discoloration, Clear elastomeric modules, Teflon coated ligature wire.

Introduction

The demand for aesthetic orthodontic appliances has increased considerably because contemporary orthodontics in today's world strives to cater to a larger number of adults.The use of clear elastomeric modules and Teflon coated stainless steel ligatures has enhanced the aesthetic value of these appliances.

Many studies[1,2,3,4,5] have evaluated the effects of the oral cavity on the elastic properties of elastomeric ligatures, such as force decay, friction and dimensional changes. However, researchers have shown little concern about the potential of any bleaching agent in reducing discoloration which has caused after intraoral exposure of these esthetic ligatures.

From past many years Hydrogen peroxide has been used in dentistry to bleach the teeth. It is a clear, colourless liquid with no odour and the molecular formula is H_2O_2 and its molecular weight is 34.0128. Hydrogen peroxide is relatively unstable and decomposes slowly to release oxygen. It is an extremely strong oxidizing agent.

Possible concerns with the intra-oral use of hydrogen peroxide are effects on soft tissues, teeth and dental restorative materials. But studies[6,7,8,9,10] had shown, no generalized mucosal irritations or clinically significant staining of the tongue or teeth on prolonged use of Hydrogen peroxide mouth-rinse in low concentration (1.5%).

From the available evidences,[8,9,10] Hydrogen peroxide mouthrinse (1.5%) had been used as an agent in this study to evaluate the reduction in discoloration of esthetic ligation methods after intra-oral exposure and also to observe effect on periodontium.

Materials and Methods

Four types (Fig. 1) of esthetic ligation methods used in this study were: Standard clear elastomeric modules **(AO)** (American Orthodontics, Sheboygan, Wis), Alastik Easy-To-Tie **(3M)** (3M Unitek, Monrovia, California, USA), Clear Super-slick modules **(TP)** (Super Slick®; TP Orthodontics, La Porte, Indiania, USA) and a Teflon coated ligature wire **(TEFLON)** (Ormco).

A sample of 30 patients was taken who were undergoing orthodontic treatment. The sample was shortlisted on the basis of absence of habits i.e. Alcohol consumption and Smoking. Mouthwash used was Hydrogen peroxide mouthwash (1.5%) - Speedrox (SPACE Pharmaceuticals Pvt. Ltd. Ahmedabad, India) to test the reduction in discoloration.

A split-mouth design was employed for clear elastomeric modules and Teflon coated ligature wire. Wherein AO was placed in the first quadrant, 3M in second quadrant, Teflon in the third quadrant and TP in the fourth quadrant.

Five elastomeric modules and ligature wire of each type were tested at three different time period: T0-As received state, T1-after 3 weeks of intra oral exposure, T2- after 3 weeks of intra oral exposure with hydrogen peroxide mouthwash twice daily (after breakfast and before going to sleep) in a dilution of 1:4 (i.e. one part of mouthwash and four parts of water).

Their change in color dimensions were observed through digital SLR camera, Canon 60D. The digital camera was set to manual mode, which allowed total control of the shutter speed and aperture size. The shutter speed was set at 1/5 seconds with an aperture of F32, and the film sensitivity was set at International Organization for Standardization 200 sensitivity mode with 1:1 lens magnification. In order to calibrate the red, green, and blue (RGB) values of the images, the white balance was set to customized 'preset mode' following the manufacturer's instructions using a standard grey card. The camera was fixed with an adaptor and digital images were taken in a darkroom. As a light source, Compact Fluorescent Lamp (40W) used. The fluorescent lights were bidirectionally fixed at an angle of 45 degrees where the elastomeric modules and ligature wire with polycrystalline brackets were placed. A standard grey card was used because neutral light grey is considered to be the ideal background for shade matching (*Paravina*,[11] 2002).

Digital image files were opened in photographic software (Adobe Photoshop, version 8.0; Adobe Systems Inc., San Jose, California, USA). Four areas (average 5 × 5 pixels) were randomly selected using the 'eyedropper' tool. The CIE *L* *, *a* *, and *b* * values of each area were obtained using the 'Lab sliders' in the software. *L* * is in the range of 0 – 100 and *a* * and *b* * in the range of − 120 to 120. The *L* *, *a* *, and *b* * values were calculated by averaging the four areas of each specimen. The three-dimensional CIE Lab colour order system provides a useful standardization technique for colour difference assessments. The system includes three colour co-ordinates. CIE *L** corresponds to the value (degree of lightness) in the Munsell system, and *a** and *b** co-ordinates designate the positions on the red/green and yellow/blue axes, respectively (+ *a* = red, − *a* = green; + *b* = yellow, − *b* = blue). Colour difference (Δ *Eab*∗) was calculated as:

$\Delta E = \{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2\}^{1/2}$

The advantages of this system for colour measurement is that it represents human sensitivity to color more closely and equal distances in this system approximate the perceived color differences.

Statistical Analysis: One way ANOVA and Post-hoc Bonferroni multiple comparison tests were performed

Results

After intra oral exposure of 21 days, ΔE (change in color) for first quadrant is 51.30±0.43, for second quadrant is 47.24±0.82, for third quadrant is 3.77±0.32, for fourth quadrant is 43.24±0.57. (Table 1)

After intraoral exposure of 21 days with Hydrogen peroxide mouthwash, ΔE observed for First Quadrant is -14.48±0.43, for Second Quadrant is -11.64±0.23, for Third Quadrant is ΔE= -2.30±0.40 and for Fourth Quadrant is -16.89±0.82. (Table 2)

Table 1: Change in color (Delta E) of elastomeric modules in the presence of hydrogen peroxide mouthwash in contrast to the absence of hydrogen peroxide mouthwash

Time Interval	Average Delta E		T-value	P-value	Mean difference
	Mean	S. D.			
After 21 days without mouthwash	36.39	19.55	5.503	0.000*	25.06
After next 21days with mouthwash	11.33	5.70			

Graph 1: Reduction in discoloration of elastomeric moduels in the presence of hydrogen peroxide mouthwash in contrast to the absence of hydrogen peroxide mouthwash

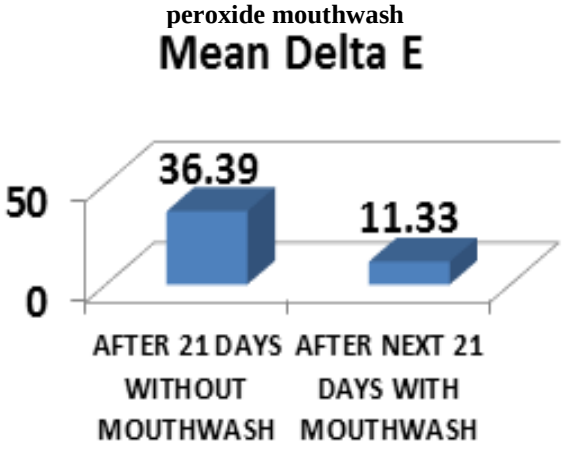
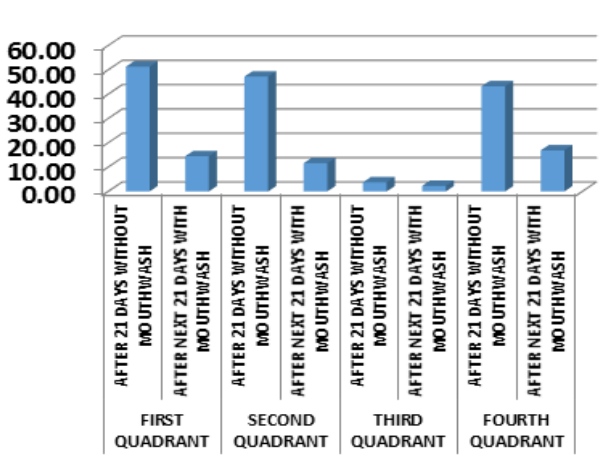


Table 2: Quadrant wise values of discoloration (Delta E) of different ligation methods in absence and presence of Hydrogen peroxide mouthwash

Quadrant	Time Interval	Average Delta E		T-value	P-value	Mean difference
		Mean	S.D.			
First Quadrant	After 21 days without mouth wash	51.30	0.43	135.603	0.000	36.81
	After next 21 days with mouth wash	14.48	0.43			
Second Quadrant	After 21 days without mouth wash	47.24	0.82	94.052	0.000	35.60
	After next 21 days with mouth wash	11.64	0.23			

Third Quadrant	After 21 days without mouth wash	3.77	0.32	6.371	0.000	1.467
	After next 21 days with mouth wash	2.30	0.40			
Fourth Quadrant	After 21 days without mouth wash	43.24	0.57	-120.51	0.000	-31.69
	After next 21 days with mouth wash	16.89	0.82			

Graph 2: Quadrant wise representation of discoloration of different ligation method in absence and presence of hydrogen peroxide mouthwash



Discussion

The study had revealed that there was significant amount of reduction in discoloration of elastomeric modules for a similar sample in the presence of hydrogen peroxide mouthwash in contrast to the absence of hydrogen peroxide mouthwash. (ΔEab without mouthwash was 36.39±19.55 while ΔEab with mouthwash was 11.33±5.70).

Among the quadrants after 21days of intraoral exposure, the order of discoloration was: First Quadrant > Second Quadrant > Fourth Quadrant > Third Quadrant.

After 21 days of intraoral exposure with Hydrogen peroxide mouthwash, observed order of discoloration was: Fourth Quadrant > First Quadrant > Second Quadrant > Third Quadrant.

But the discoloration shown by TEFLON coated ligatures after 21days of intraoral exposure with Hydrogen peroxide mouthwash was not clinically significant as it was lesser than 3.3 units (ΔE=2.30±0.40)

Amongst the modules that the effect of Hydrogen peroxide mouthwash was highest in the First Quadrant (Mean difference =36.81) > Second Quadrant (Mean difference=35.60) > Fourth Quadrant (Mean difference=26.35) > Third Quadrant (Mean difference=1.467).

The photographic setup used in our study comprised of a tripod that held a digital single reflex camera (Canon EOS 60D) with a 100mm macro lens as used in previous studies like *Sung-Hee Kim* and *Yong-Keun Lee*[12] in 2009 and *Andréia Viana Martins da Silva et al.*[13] in 2012.

No evidence was reported regarding soft tissue irritation and inflammation with the use of Hydrogen peroxide mouthwash. It was also observed that in four patients there was reduction in gingival inflammation. In accordance with the previous studies[4,5] the use of Hydrogen peroxide mouth wash (1.5%) can be recommended to the patients undergoing orthodontic therapy for prolonged use.

Conclusion

The following principal conclusions can be drawn from the investigation:

- Hydrogen peroxide revealed statistically significant potential in reducing discoloration. So, Hydrogen peroxide is an effective agent for reduction in discoloration if used on a continuous basis, as has also been suggested in the previous studies.
- Hydrogen peroxide mouth-rinse had shown potential in reducing gingival inflammation and improvement in periodontal health, so it can be indicated in orthodontic patients who are undergoing treatment and are more prone to compromised gingival and periodontal health.
- Also, Teflon coated ligature wire had shown most superior properties in terms of resistance to discoloration. So, it can be the preferred choice for aesthetic ligation.

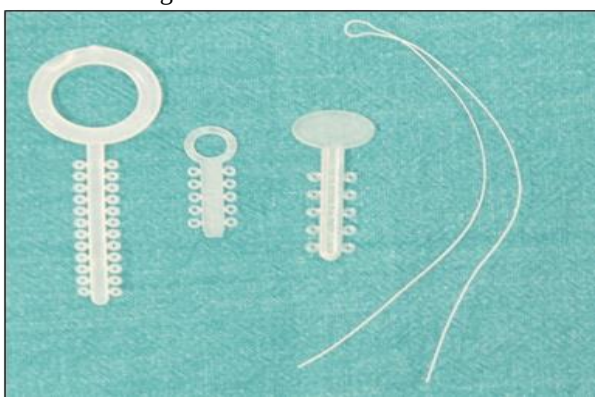


Fig. 1: Clear elastomeric modules (AO, 3M, TP) and Teflon coated ligature wire (Ormco)

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