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Effects of combining ozone and hydrogren peroxide on tooth bleaching: A clinical study

Mahmoud K. AL-Omiri[a,b,*], Ra'ed S.Abul Hassan[c], Bader K. AlZarea[d], Edward Lynch[e]

[a] School of Dentistry, University of Jordan, Amman, Jordan
[b] The City of London School of Dentistry, BPP University, UK
[c] Faculty of Allied Medical Sciences, The Royal University for Medical Sciences, Amman, Jordan
[d] School of Dentistry, Aljouf University, Sakaka, Saudi Arabia
[e] Dentistry, Warwick Medical School, Coventry CV4 7AL, UK

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ABSTRACT

Objectives: The purpose of this study was to evaluate the efficiency of bleaching after combining ozone and 38% H_2O_2 in comparison to the sole use of 38% H_2O_2.
Methods: Consecutive 26 participants (13 males and 13 females) were recruited into this study. They were randomly allocated into 2 groups (n = 13 for each group). In group 1 (test group); the participants' upper anterior teeth were treated with 38% H_2O_2 for 20 min then the teeth were exposed to ozone for 60 s (healOzone® X4, KaVo Dental, Biberach, Germany). In group 2 (controls); the upper anterior teeth were treated with 20 min of 38% H_2O_2 only. The shade of teeth was evaluated by recording the L* a* b* values and Vita Classic shades at study baseline and after bleaching in both groups. The statistically significant changes were set at $P \leq 0.05$.
Results: Tooth sensitivity and teeth shades were comparable between groups at study baseline ($p > 0.05$). Controls reported more tooth sensitivity following bleaching ($p < 0.001$). Teeth achieved better Vita shades, higher L* values (lighter shades), and lower a* and b* values (lighter shades) after bleaching in both groups ($P \leq 0.05$). However, teeth bleached with H_2O_2 and ozone achieved better Vita shades, higher L* values and lower a* values (lighter shades) than those bleached with H_2O_2 alone ($p < 0.001$). Changes in b* values were not significantly different between groups.
Conclusions: Bleaching with 38% H_2O_2 for 20 min followed by 60 s of ozone application would result in teeth with lighter shades than bleaching with 38% H_2O_2 alone.

1. Introduction

Ozone therapy has gained popularity and acceptance among dental and medical professionals. It has been indicated for the treatment of more than 250 different pathologies [1–6]. This is due to some interesting properties of ozone including it being amongst the top most effective known oxidants, stimulates blood circulation and immune response, has analgesic properties, and possesses strong antimicrobial activity against viruses, bacteria, fungi, and protozoa [1,2].

Ozone therapy is one of the treatment modalities used for some dental aspects including tissue regeneration [2–11], tooth surface remineralization [3–5,7–11], prevention of dental caries [7–11], infection control [1–5,12], acceleration of healing [3–6,13,14], bleaching [15–17], management of tooth sensitivity and exposed roots [3–5,18–20], oral ulcer treatment [6], periodontal pocket disinfection [21,22], pain control [1–6,23], endodontic treatment [3–5], control of halitosis [3–5], TMJ treatment [3–5], and biofilm purging [1–5].

Different ozone generating machines were used for dental purposes, and safe machines are currently available and in use for humans [10–12,15–17].

The literature lacks clinical studies on the role of ozone in dental bleaching. Furthermore, the available studies in this regard are limited, are laboratory based and reported conflicting results [16,17,24–26].

* Corresponding author at: School of Dentistry, The University of Jordan, Amman 11942, Jordan.
E-mail address: alomirim@yahoo.co.uk (M.K. AL-Omiri).

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Tessier et al. demonstrated that ozone could improve the shades of tetracycline stained incisor teeth in rats. [25] In addition, some researchers found that ozone was able to bleach teeth as effective as 45% carbamide peroxide. [26] AL-Omiri and co-workers found that ozone had synergistic effects on H_2O_2 bleaching of extracted human teeth, and that ozone had similar bleaching outcomes like 38% H_2O_2 [16,17].

However, other researchers demonstrated that ozone did not improve the bleaching efficiency of 8% carbamide peroxide, and that ozone reduced the efficiency of bleaching when applied before the use of 8% carbamide peroxide [24]. Furthermore, some researchers claimed that ozone did not potentiate the bleaching capacities of 35% peroxide and that the peroxide provided better bleaching for dental specimens stained with tea pigments than ozone [27].

Previous studies in this regard had different designs and endured some drawbacks including utilizing unsafe machines to generate ozone [10,26,27], applying experimental settings that cannot be applied clinically [26,27], investigating non human teeth [25], recording shade changes via unstandardized subjective visual shade guides [25,26], recording hue component of the shade only [25], testing very small sample sizes [24,27], bleaching extrinsic artificial tea staining [24,27], or not measuring the amounts of ozone delivered by the devices used [24,25,27].

This motivated the conduction of the current study in order to investigate the role of ozone in dental bleaching within clinical settings.

The aim of this study was to clinically evaluate the efficacy of bleaching upper anterior teeth following application of 38% H_2O_2 for 20 min and ozone for 60 s in comparison to the sole application of 38% H_2O_2 for 20 min.

The null hypothesis for this study was that application of 38% H_2O_2 for 20 min and ozone for 60 s has similar bleaching effects to the sole use of 38% H_2O_2 for 20 min.

2. Materials and methods

Twenty six consecutive participants (13 males and 13 females) were recruited into this study. Participants age ranged from 20 to 35 years old (mean = 27 ± 5 years). The participants were recruited from visitors to dental clinics at University of Jordan. The study was approved by Deanship of Research, University of Jordan, Amman, Jordan.

Each participant was provided with full explanation of the study and the procedures to be followed. Participants' written informed consent was obtained before being recruited into the study.

Participants were included in the study if they had all upper anterior teeth from right canine to left canine, if the upper anterior teeth are sound, if they never had their teeth bleached before, if their upper anterior teeth had A3 or darker Vita shades, and if they received no orthodontic, restorative or prosthetic treatment for their upper anterior teeth before. Participants with orthodontic appliances, missing upper anterior teeth, carious lesions, tooth surface loss, prosthetic rehabilitations or restorations in their upper anterior teeth were excluded from the study. Participants who had previous bleaching were also excluded.

A thorough clinical examination was performed on a dental chair set with a light unit Daray® angle poise extra-oral light source (Daray Lighting Ltd, Leighton Buzzard, and Bedfordshire, UK). All upper anterior teeth were cleaned and dried with cotton rolls and gauze. Dental oral mirror (15/16 inch, Hanhnenkratt GMBH, Germany) and explorer probe (0700-9 anatomical handle single ended, ASA Dental Co, Italy) were used during the intra-oral examinations.

Participants' teeth were scaled and polished before starting the experiment. Then, tooth sensitivity was assessed using a visual analogue scale (VAS) from 0 to 10. Zero means no sensitivity of teeth and 10 means the most severe sensitivity of teeth. After that, the shade of the upper anterior teeth (from upper right canine to upper left canine) of each participant was recorded from fixed distance (7 cm from the tooth surface) while the patient was setting upright in the dental chair. The colorimeter was mounted on a movable metal tray attached to the vertical column of the dental chair light unit. A 7 cm long plastic rod was used between the centre of the measured tooth surface and the centre of the colorimeter aperture before securing the final position of the movable tray, and thus the colorimeter was fixed at 7 cm from the tooth surface during shade measurement. The lighting conditions were also standardized by taking all shade records under natural light while the lights of the clinic room were turned on and the dental chair light was on and directed away from the patient. To help precise shade recording; the shade of the upper anterior teeth was recorded in the same order for each patient (from right canine to left canine).

The shade was recorded via the Colorimeter Konica-Minolta CR-400 (Minolta Inc, Osaka, Japan) which measures Vita classic shades and L* a* b* shade values by recording the intensity of reflected visible light for red, blue, green, and yellow wave lengths utilizing the L*a*b* coordinates of colour space in CIELAB colour system. [28,29] The L* value determines lightness and ranges from zero to 100, the a* value determines redness (+a*) or greenness (−a*) and ranges between −90 and 70, while the b* value determines yellowness (+b*) or blueness (−b*) and ranges from −80 to 100. [30].

The participants were then randomly distributed into two groups; test and control groups (n = 13 for each group).

Then, the facial surfaces of participants' anterior teeth in the test group were treated using 38% hydrogen peroxide professional whitening gel for 20 min (BMS white 38%, BMS Dental, Italy); then the gel was removed by suction, and washed with water for 10 s according the manufacturers' recommendations. After that, the teeth were exposed to ozone for 60 s. The delivered ozone concentration was 2350 ppm at a flow rate of 615 cc per minute, and was generated by healOzone X4 machine (healOzone X4, KaVo Dental, Biberach, Germany) [6,16,17,22]. The ozone was applied to teeth using special disposable silicone cups provided by the manufacturer. The used silicone cups ensured complete seal and prevented gas escape as the machine is designed to work only if the cup ensures perfect seal, and thus this ensures the safety of the machine for human use. After that, the teeth were left for 24 h to allow rehydration of tooth surfaces and the shade was then recorded as above. Tooth sensitivity for each tooth was also assessed 24 h after bleaching using VAS scale from 0 to 10 as above. Zero means no sensitivity of teeth and 10 means the most severe sensitivity of teeth.

On the other hand, the facial surfaces of participants' upper anterior teeth in the control group were treated using 38% H_2O_2 for 20 min following the same procedures used for the main group. Then the teeth were exposed to air for 60 s using the healOzone machine which is specially designed with a switch at the back of the machine which was switched to deliver only air and no ozone. After that, the teeth were left for 24 h to allow rehydration of tooth surfaces and the shade was then recorded as above. Tooth sensitivity for each tooth was also assessed 24 h after bleaching using VAS scale from 0 to 10 as above. Zero means no sensitivity of teeth and 10 means the most severe sensitivity of teeth.

Two investigators conducted the experiment. One investigator (M.K.AL-O.) carried out the bleaching for all participants and the other (R.S.A.H.) recorded the shades for all participants in this study. The investigator who carried out the shade readings was blinded to which bleaching protocol had been applied for each participant.