

## BIOLOGICAL CONSIDERATIONS IN IN-OFFICE VITAL BLEACHING PROCEDURE – A SYSTEMATIC REVIEW

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### ABSTRACT

**Background:** To assess the effects of In-Office vital bleaching procedure using Hydrogen Peroxide 35% on Enamel Sensitivity. **Objective:** To assess the effects of In-Office vital bleaching procedure using Hydrogen Peroxide 35% on Enamel Sensitivity. **Data Source:** Electronic search of PubMed, Google Scholar, Institutional Library and Research gate. **Study Eligibility Criteria:** The following criteria was used to select the studies on sensitivity of enamel due to in-office vital bleaching procedure using Hydrogen Peroxide. The inclusion criteria were studies in English or those having detailed summary in English, studies that provide information on sensitivity of enamel on bleaching. Studies that were published between 1st January 2000 till date. Clinical Trials were selected. The exclusion criteria were case reports, abstracts, letters to editors, editorials and in vitro studies. Studies that did not use Hydrogen Peroxide in in-office Vital Bleaching Procedure. **Intervention:** Hydrogen Peroxide was selected as the intervention with a specific concentration of 35%. **Results:** Various electronic databases were searched using different search strategies from the above mentioned key words and the combinations. The number of articles identified through the database searching were 226 in all. After thorough reading of tittles the number of articles found relevant were only 48. Further these records were assessed for any duplicates and 37 duplicate articles were removed whilst including 11 articles. Full text thorough reading of these 11 articles was done and were assessed for eligibility. Only 7 articles were qualified and 4 articles were excluded. **Conclusions:** The available evidence on this topic is scarce, and the findings of studies were not consistent. Additional randomized clinical trials using clinical outcomes to evaluate the sensitivity of enamel after bleaching with 35% Hydrogen Peroxide are needed.

**KEYWORDS:** Enamel, Hydrogen Peroxide, Bleaching.

### INTRODUCTION

Cosmetic dentistry has is an important part of restorative dental practice. The appearance of teeth is considered very important.<sup>[1]</sup> It is to patients of all ages and is often associated with a perception of health and fitness. Cosmetic procedures have become more readily available as standards of living have improved. Dentistry has also succeeded in reducing the frequency and severity of caries and periodontal diseases, which has led to the preservation of natural teeth even in older patients. White teeth are associated with good health and beauty and so lighter-colored teeth have become more desirable. It is up to our profession to offer the patients the best of treatments to achieve their goals safely. Vital tooth bleaching can be performed with a high rate of success as a more conservative measure than restorative

treatment, such as porcelain veneers, crowns or composite bonding (Barghi, 1998).

Bleaching has been accepted as the least aggressive method for treating discolored teeth. However, the effectiveness of in-office systems has been controversial. Bleaching appears to be time and concentration dependent.<sup>[2]</sup> The questions remain whether in-office tooth whitening products with lower concentrations are as effective as products with higher concentrations and whether some products are more effective than others. These types of questions have long been on the minds of dental practitioners.<sup>[3]</sup>

Compared to other restorative treatment modalities, bleaching is a conservative and easy-to-perform

procedure. In general, three fundamental vital tooth bleaching approaches exist:<sup>[4]</sup>

1. An at-home, but dentist-supervised application of a bleaching gel-filled night guard system.
2. An in-office or power bleaching application by a dental professional.
3. Over-the-counter bleaching products used by patients at home without the supervision of a dental professional.

In-office bleaching is an appropriate treatment of choice especially in severe discoloration cases, in the presence of a lack of patient compliance, or if a rapid result is desired.<sup>[4]</sup> Compared to home bleaching, in-office bleaching offers the advantages of control by the clinician, prevention of ingestion of the peroxide material, and a reduction of the total treatment time.<sup>[3]</sup> Even though professional-assisted dental bleaching is considered a safe procedure, tooth sensitivity (TS) is a remarkably common side effect reported by patients. More than 70% of patients who undergo in-office bleaching complain of TS, which leads some patients to forego treatment. The uncomfortable and painful bleaching-induced TS is likely the result of pulp insult by the rapid diffusion of HP molecules.<sup>[5]</sup> The bleaching process occurs because the low molecular weight of hydrogen peroxide (HP) allows it and its derivatives (reactive oxygen species – ROS) to diffuse easily through enamel and dentin.<sup>[6,7]</sup> Various authors have demonstrated that application time,<sup>[8]</sup> heat activation,<sup>[9,10]</sup> and the concentration of peroxide and other chemical components can influence the diffusion of ROS through hard tooth tissues and the extent of pulp penetration. Variations in enamel and dentin thickness may also determine the diffusion of products released from bleaching gels through enamel and dentin. These differences can result in varying degrees of pulp damage. Therefore, the association of these factors may generate sensitivity after tooth bleaching.<sup>[9,10,11,12,13,14]</sup>

The recent popularity of bleaching has given rise to many papers being published in major dental journals. However, most of the research has evaluated and compared the bleaching efficacy of commercial products used on hard tooth tissues, rather than the biological safety of this clinical procedure. According to the FDA (Food and Drug Administration), a drug can be considered safe when its components generate a low incidence of adverse reactions or side effects when applied according to the manufacturer's instructions. Clinical reports reveal that most patients exhibit post-bleaching tooth sensitivity.

Now in consideration to this outcome of Post bleaching sensitivity the main aim of this systematic review is to evaluate the effect of hydrogen peroxide (HP) on the sensitivity of enamel when used for in-office Vital Bleaching Procedure.

### Focused Question

What is the effect of In-Office vital bleaching technique using Hydrogen Peroxide 35% on Enamel Sensitivity?

### OBJECTIVES

To assess the effects of In-Office vital bleaching procedure using Hydrogen Peroxide 35% on Enamel Sensitivity.

### Eligibility Criteria

#### Inclusion Criteria

This included articles and studies based on some fixed guidelines.

- 1) Articles in English or those having detailed summary in English.
- 2) Studies published between 1<sup>st</sup> January 2000 and 31<sup>st</sup> December 2015.
- 3) Studies done on adults aged more than 18 years.

#### Exclusion Criteria

- 1) Review, case reports, abstracts, letters to editors, editorials and in vitro studies are excluded.
- 2) Studies assessing the biological consideration in vital bleaching procedure other than in-office bleaching technique.

### The PICOS guidelines that were selected are

P where participants were included and this comprised of people of age group more than 18 years of age. I as the Intervention where this was considered as 35% Hydrogen Peroxide in In-Office Vital Bleaching Technique. C as comparison and this review did not aim to compare any of the parameters. O as the outcome where it was assessed as the effect on enamel sensitivity. And hence the PICOS are mentioned below:

P - Participants: People of age group more than 18 years  
I - Intervention: 35% Hydrogen Peroxide in in-office vital bleaching technique.

C-Comparison-

O - Outcome: effect on enamel sensitivity.

S - Study design: Clinical Trial

### Information Sources

Prospective studies were selected towards the sensitivity of enamel on application of 35% Hydrogen Peroxide in In-Office Vital Bleaching Procedure. English-language articles were retrieved from electronic biomedical journal databases. The databases searched were PubMed, Google Scholar and Researchgate.

## Search Keywords

Enamel	Enamel, sensitivity, colour change.
Vital bleaching	Tooth whitening, bleaching, in-office bleaching, at-home bleaching, esthetics, cosmetics.
Hydrogen peroxide	Peroxide, HP,35%,Opalescence Boost, Opalescence XtraBoost, carbamide peroxide, bleaching agent.

Sr. No	Search Strategies	Number of Articles	Selected	After Removal of Duplicates
1	Enamel AND Tooth bleaching AND Peroxide	95	34	7
2	Enamel AND in-office bleaching	70	5	2
3	35% H.P AND Vital Bleaching	31	5	0
4	Enamel sensitivity AND in-office bleaching AND 35% hydrogen peroxide	1	1	2
5	Enamel colour change AND in-office bleaching AND 35% hydrogen peroxide	1	1	0
6	Enamel colour change AND at-home bleaching AND 35% hydrogen peroxide	3	1	0
7	Enamel colour change AND tooth whitening AND 35% hydrogen peroxide	12	1	0
8	Opalescence boost AND in-office bleaching AND enamel	8	0	0
9	Enamel colour change AND vital bleaching AND 35% hydrogen peroxide	5	0	0
<b>Total</b>		226	48	11

## Study Selection

Clinical trials and randomized clinical trials were selected; however, only articles where the effect of 35% Hydrogen Peroxide on enamel sensitivity in population above the age of 18 years were included. There is a great variability in Pulpal Blood Flow among patients, and this is the reason that the variation in the pulp flow can be assessed for each patient in an intra individual comparison. This reduces the variability of the measurement and is a viable method to assess the effect of some restorative and cosmetic protocols on pulp vitality, including bleaching protocols.

In in-office bleaching using higher concentrations of HP is the alternative protocol. This protocol has been shown to produce color changes more rapidly Even though professional-assisted dental bleaching is considered a safe procedure, tooth sensitivity is a remarkably common side effect reported by patients. More than majority of patients who undergo in-office bleaching complain of Tooth Sensitivity.

Various electronic databases were searched using different search strategies from the above mentioned key words and the combinations. The number of articles identified through the database searching were 226 in all. After thorough reading of titles the number of articles found relevant were only 48. Further these records were assessed for any duplicates and 37 duplicate articles were removed whilst including 11 articles. Full text thorough reading of these 11 articles was done and were assessed for eligibility. Only 7 articles were qualified and 4 articles were excluded. 2 articles were excluded as they supported the use of elementary light source. 1 article was excluded as the intervention was used in at-home bleaching process and not in in-office bleaching process. 1 article was excluded as it supported the use

desensitizing agents. In all, these articles were excluded as they did not qualify for the methodology selected.

## Data Collection Process

Data collection process was done according to the consultation approved from our expert. First a Pilot Microsoft Excel Sheet was filled accordingly and then the expert was consulted for further progress. According to the data collected and the records selected the remaining Excel sheet was filled only with the data that was related to this study and retained.

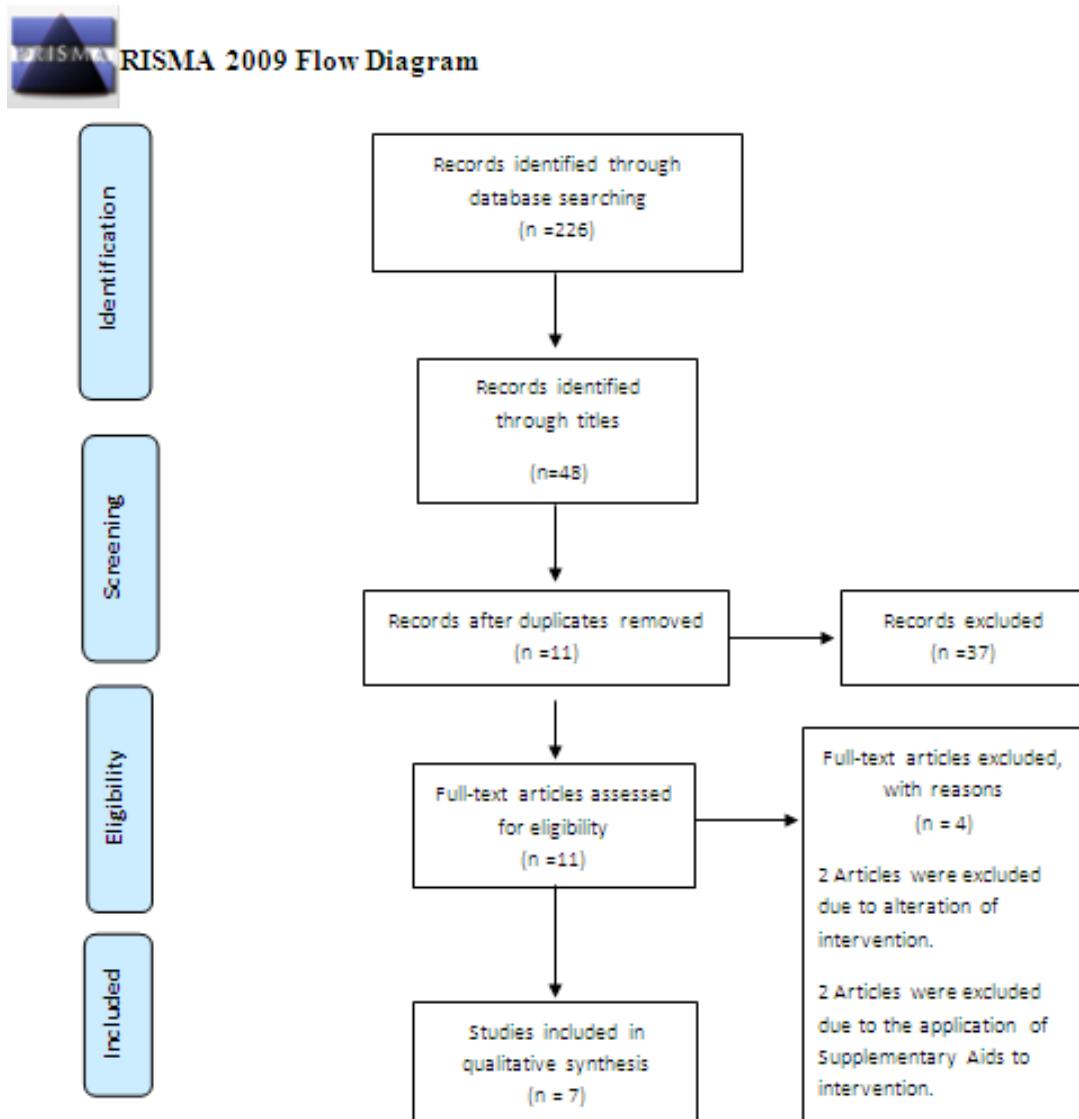
## Data Items

The headings under which the data was tabulated are:

- 1) Study Number- where the number of studies that were selected were mentioned number wise.
- 2) Name of the Author- as an important factor.
- 3) Location of the study- was also mentioned.
- 4) Year of Publication- Mentions the year in which the article got published.
- 5) Study Design- Was mentioned as to specify the type of study design for example clinical trial, randomized clinical trial whether the study was in vivo, in vitro or in situ.
- 6) Sample Size- Was mentioned to specify the number of volunteers who participated in each study.
- 7) Intervention- It was selected as the Hydrogen Peroxide with a specific concentration.
- 8) Duration of Bleaching- Was specified according to the various studies undertaken.
- 9) Sensitivity- This being the main outcome was specified according to the agent selected and methodology applied.
- 10) Evaluation Time- This was different for each study and so it was specified.
- 11) Outcome (Post Bleaching)- Was mentioned as the value was recorded according to the patients

- experience and their own numerical gradations according to the major number of articles.
- 12) Result- Was mentioned according to the study's protocol and in the authors original words.
- 13) Remark- Was expressed by the author of this systematic review.

### Study Selection



## DISCUSSION

### Summary of Evidence

With increased patient demand for esthetic improvements, bleaching has become a popular treatment in dentistry, and new bleaching products are being introduced to the practice. Sensitivity is also a consideration which affects the patient's mindset towards the bleaching protocol. So this review aimed at evaluating sensitivity after bleaching. In this review, 7 articles were selected according to the above mentioned Inclusion and exclusion criteria.

R Zekonis *et al* conducted a three-month single-blind clinical study where he compared two whitening treatments, at-home with 10% carbamide peroxide and in-office with 35% hydrogen peroxide, for the degree of

color change of teeth, color relapse and tooth and gum sensitivity.<sup>[15]</sup> Teeth and gum sensitivity were self-evaluated by the subjects, who recorded daily the tooth and gum sensitivity they experienced during the two weeks of treatment and one week post-treatment. A 14-day at-home treatment was compared with 60 minutes of in-office treatment (two appointments, each with three 10-minute applications). The graph shows that there was no change in the sensitivity from the 1st day to 6th day but it shows a gradual increase in the sensitivity on the 7th day. The sensitivity decreased after 7th day and was constant till day 13. On the 14th day it again shows a gradual rise in the sensitivity value and decreases by day 16. After that there was no sensitivity detected. At-home treatment had significantly higher gum sensitivity than in-office treatment during the latter part of first week of

the study. For tooth sensitivity, there were no significant differences between treatments. 84% of the subjects reported the at-home treatment to be more efficient and 16% reported no difference in lightness between the treatments. None of the subjects reported the in-office bleaching treatment to be superior to the at-home bleaching treatment.

S Al Shethri *et al* conducted a half-mouth design study with a two-week treatment phase, combined with an 11-week evaluation double-blinded randomized clinical trial to compare two in-office bleaching products, StarBrite (35% hydrogen peroxide) with Opalescence Xtra Boost (38% hydrogen peroxide), for degree of color change of teeth, any relapse effect (darkening) associated with discontinued use and gingival irritation and tooth sensitivity associated with use.<sup>[1]</sup> Tooth sensitivity was defined as any sensitivity from cold temperature. It was recorded by the candidates into 5 categories 1)none, 2)slight, 3)moderate, 4)considerable or 5)severe. The graph shows that initially there was no tooth sensitivity before bleaching but it shows that sensitivity increased on the 2nd day after bleaching and subsided on the 3rd day. Again after 7 days there was an increase in the sensitivity for 2 days and subsided on the third day as previous. Also, there was no statistical difference in gingival irritation and tooth sensitivity between the products.

FC Marson *et al* clinically evaluated the alteration of color, color stability, dental sensitivity and gingival irritation on patients undergoing dental bleaching using varying bleaching methods and light-activation sources. According to pre-established criteria, 40 patients were selected and randomly divided into four groups (n=10): Group 1–35% Hydrogen Peroxide (HP); Group 2–35% HP plus Halogen Curing Light XL 3000 (3M/ESPE); Group 3–35% HP plus Demetron LED (Kerr) and Group 4–35% HP plus LED/LASER (Bio-art).<sup>[16]</sup> For all groups, there were two sessions of bleaching with 35% HP, with a one week break between sessions. At each bleaching session, three applications of the bleaching gel were used. Tooth sensitivity was verified with a light air jet over the labial surface of the teeth. The degree of sensitivity was recorded using the following criteria: 1-none, 2-slight, 3-moderate and 4-severe. For 35% Hydrogen Peroxide the sample size was 10 of which 4 patients recorded tooth sensitivity as none, 2 patients had slight sensitivity and 4 patients recorded moderate sensitivity. Sensitivity was recorded immediately after the first application and after the second application. No sensitivity was recorded 24 hours after the treatment. Tooth sensitivity probably occurred due to a high concentration of the bleaching gel and the length of application (35% HP, 45 minutes). Tooth sensitivity occurred immediately following bleaching, but a higher degree of sensitivity was recorded after the second bleaching session. Tooth sensitivity that occurred immediately following bleaching was probably due to the high concentration of peroxide.

Qasem Alomari and Ehsan Al Daraa evaluated the effect of four in-office dental bleaching methods on shade change, color stability, patient satisfaction and postoperative sensitivity. Forty patients were randomly divided into four groups (n=10) according to the method of in-office bleaching used: Group A—35% hydrogen peroxide (HP); Group B—35% HP plus BriteSmile and a blue curing light; Group C—35% HP plus QuickSmile and an LED curing light; Group D—35% HP and a Zoom2 metal halide curing light.<sup>[4]</sup> For all groups, there was only one session of bleaching with three 20-minute applications of bleaching gel. Tooth sensitivity was evaluated by blowing air from air-water syringe of the dental unit over the labial surfaces of the upper anterior teeth for 5 seconds. The degree of sensitivity was recorded according to the following criteria: 0-no sensitivity 1-slight sensitivity 2-moderate sensitivity 3-severe sensitivity. Immediate postoperative sensitivity was the least in Group A and the highest for Group B. This sensitivity typically was mild in severity and transient in nature, and often resolved after active treatment. About 70% of the patients had tooth sensitivity immediately after bleaching. The sensitivity was mild and tolerable in all of the participants and disappeared within one month following treatment in all of the groups. Chemical bleaching alone caused less sensitivity.

Lidia Yileng Tay *et al*, evaluated the 2-year bleaching efficacy and sensitivity produced by at-home and in-office bleaching therapies. 60 participants with tooth color darker than C2, without restorations in the anterior dentition and older than 18 years old, were randomly allocated into two groups to receive either IO with 35% hydrogen peroxide or AH with 16% carbamide peroxide.<sup>[17]</sup> Color was recorded at baseline (BA); 1-week (1W); end of the treatment (ET); and 2 years (2Y) after bleaching, using the Vita Classical shade guide. Sensitivity was recorded to according to the 5-point Numerical Rating Scale, with the following criteria: 0-none, 1-mild, 2-moderate, 3-considerable and 4-severe. The intensity of tooth sensitivity was compared using Mann-Whitney test. The sample size was 30 for the group which was exposed to 35% Hydrogen Peroxide. 26 volunteers experienced sensitivity from mild to moderate and only 4 patients did not experience tooth sensitivity. Regarding tooth sensitivity intensity, there was a statistical difference between the bleaching therapies ( $P = 0.001$ ). Most of the participants from the at-home group experienced none to mild sensitivity, while most in the in-office bleaching group experienced mild to moderate sensitivity. At 2 years, none of the participants reported tooth sensitivity.

Letícia C.A.G. de Almeida *et al*, evaluate the effect of tooth bleaching with 10% carbamide peroxide (CP) or 35% hydrogen peroxide(HP), with or without quartz-tungsten-halogen light or hybrid source LED/infrared laser exposition on the occurrence, duration, intensity and location of tooth sensitivity.<sup>5</sup> Forty patients were

selected and randomly divided into four groups: 35 % in front of hydrogen peroxide GI – home bleaching with CP for 4 hours a day, over the course of 3 weeks; GII – three sessions of HP, with three 10-minute applications at each session and no light source; GIII – the same procedure as GII with quartz-tungsten- halogen light irradiation; GIV – the same procedure as GII with LED/laser light irradiation. The intensity of sensitivity was recorded using an analog scale with values from 0 to 10. Zero values were established for patients with no sensitivity, values of 10 represented patients that reported unbearable pain sensitivity. 0- No sensitivity, 1- Only during bleaching session or tray use, 2- Up to 12 hours after bleaching, 3- More than 12 hours after bleaching. The sample size was 40 for this study and where 35 patients reported sensitivity and only 5 patients did not experience any sensitivity. In the group where only 35%HP was applied without any light source 8 patients have experienced sensitivity in the anterior region whereas 2 patients have experienced generalised sensitivity. Forty volunteers completed the study. Only 5 patients (12.5%) reported no pain throughout the entire treatment. There was no report of sensitivity 7, 30 or 180 days after the end of treatment.

Andres Felipe Cartagena *et al*, evaluated measures of changes in Peripheral Blood Flow by Laser Doppler Flowmetry in the upper central incisor of three patients submitted to in-office bleaching.<sup>[18]</sup> Sensitivity was measured on a 5-point verbal rating scale during bleaching up to 1 week after bleaching. 0-none,1-mild,2-moderate,3-considerable and 4-severe. The incidence of sensitivity ranged from moderate to considerable after bleaching. One week after the procedure, the patients reported only mild tooth sensitivity. All three participants from this study experienced moderate to considerable Tooth Sensitivity that decreased to a mild level one week after bleaching. The literature usually reports that Sensitivity normally persists for up to four days after bleaching but durations of up to 39 days have been reported.

From the seven included studies all the studies had an adequate sample size except for the studies done by R Zekonis *et al.*<sup>[15]</sup> S Al Shethri *et al.*<sup>[1]</sup> who conducted study on 19 and 20 patients respectively and Andres Felipe Cartagena<sup>[18]</sup> who reported a study with only three subjects. The maximum duration of bleaching for the studies selected was from 90-120 minutes. While the study conducted by Andres Felipe Cartagena<sup>[18]</sup> reported change in tooth sensitivity following a 45 minute total cycle. Because of the difference in total duration of bleaching cycle the results obtained in these studies were different with the study conducted with shorter duration reported sensitivity to vanish in just 1 week while the other studies reported with sensitivity to reduce in 1 month after bleaching. This may be because of the exposure to Hydrogen peroxide was of limited time and duration. Only one session of 45 minutes was carried out which reduced the exposure time leading to faster relief

from sensitivity. Ideally sensitivity should be examined 1 week with a follow up upto 6 months after the bleaching protocol. And in the included studies five studies followed this protocol while the study conducted by Qasem Alomari<sup>[4]</sup> and Ehsan Al Daraa evaluated the sensitivity immediately after the bleaching protocol. Immediately after bleaching the tooth is rendered water less as exposure to Hydrogen Peroxide or any bleaching agent results in precipitation of the water content of the tooth. So sensitivity is a very vulnerable test for the tooth at such interval as the stimuli directly aggrevates the pulp fibres. Lidia Yileng Tay *et al.*<sup>[17]</sup> conducted a study to check sensitivity post bleaching at the end of one week and a follow up after two years. Two years is a very long duration to check sensitivity of tooth as sensitivity is relieved after one month with a maximum duration of 6 months. So keeping a follow up of two years for sensitivity is irrelevant and cannot be considered as a reliable factor.

## LIMITATIONS

- 1.) As only English language was selected the search was restricted only to this language. Other languages were not involved.
- 2.) Also the availability of literature was minimum.
- 3.) The results were tabulated in Graphs and not expressed in numerical values.

## CONCLUSION

From the available data it can be concluded that 35% Hydrogen peroxide can be considered a newer and safer bleaching agent. Though Hydrogen Peroxide causes sensitivity similar to other bleaching agents it gives a relief from the caused sensitivity in a shorter duration as compared to the other bleaching agents reported in the literature.

## FUTURE IMPLICATIONS

Further studies are required with an adequate sample size and standard duration of bleaching cycles to evaluate the sensitivity of tooth post bleaching with Hydrogen Peroxide as agent.

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