

Clinical Report

THE USE OF 10%, 16%, 22% CARBAMIDE PEROXIDE AND 3%, 7.5%, 9.5% HYDROGEN PEROXIDE MATERIALS FOR AT-HOME VITAL TOOTH BLEACHING IN COMBINATION WITH ACTIVE AND PASSIVE TREATMENT MODALITIES FOR CONTROL OF TOOTH SENSITIVITY AND GINGIVAL IRRITATION.

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INTRODUCTION

At-Home Vital Tooth Bleaching' (AHVTB) or 'Night Guard Vital Bleaching (NGVB)' has become one of the most asked for and practiced aesthetic treatment available to dentists. At home tooth whitening produces some of the most satisfying results for the patient and dentist whilst also being the most conservative form of aesthetic dentistry. In today's society where personal appearance has become very much associated with self-confidence, being able to achieve a nicer whiter smile for patients with minimal intervention can also help to build a patient's self confidence and self-esteem.^{37,12}

"As early as 1877 dental researcher discovered oxalic acid could be used to whiten vital teeth".³⁷ "In the early twentieth century, the use of 35% hydrogen peroxide was recognised as the most effective bleaching agent. In 1950, Pearson administered heat and hydrogen peroxide for non-vital teeth bleaching. In 1976, Nutting and Poe introduced the walking bleach technique, which uses 35% hydrogen peroxide and sodium perborate for non-vital teeth bleaching (Sun, 2000)."

"For Vital teeth bleaching, in 1918, Abbot used high-intensity light, raising the temperature of the hydrogen peroxide rapidly to accelerate the chemical process of bleaching. In the late 1960's, a successful technique for home bleaching was introduced by Klusmier, at which time he discovered that 10% carbamide peroxide was loaded in a mouth guard with the intent to improve the gingival condition also resulted in a bleaching effect. By March 1989, Haywood and Heymann introduced and published this technique; in the 1990's, this procedure has been used widely by the dental community (Sun, 2000)."

The whitening effect is due to the high molecular weight hydrogen peroxide decomposing rapidly into various free radical ions. These ions react with the long-chained, dark-coloured chromophile molecules, breaking into smaller, lighter coloured structures. It also could be the phenomenon of altering the optical structure of the chromophile molecule, rendering the stain invisible. Both the dentine and enamel change colour due to the easy passage of the hydrogen peroxide through the tooth structure.^{44, 12,40}

'At -Home Vital Tooth Bleaching' (AHVTB) has been studied and used for many years now and has been found to be safe and effective in whitening patients teeth. It has also been shown that AHVTB does not have any detrimental long term effects on the teeth.^{36,4,25,48}

The main transient side effects are tooth sensitivity (TS) and gingival irritation (GI), gastric irritation and sore throat have also been noted at times. The side effects on average take 2-7 days to subside, most side effects though subside before the completion of the treatment.^{1-4,8-10,12,16-19,24-28,30-34,36,37,43,46,47} Sensitivity is in the form of a reversible pulpitis caused from the dentinal fluid flow and pulpal contact of the material without apparent harm to the pulp.¹⁶ The degree of sensitivity ranges from mostly mild to moderate with occasional severe sensitivity.

"Double-blind clinical studies have shown that sensitivity occurs in 55%-75% of treatment groups. The placebo groups also experienced between 20% and 30% sensitivity. One study even reported tooth sensitivity of about 15% in

subjects wearing only the bleaching tray. Therefore it appears that sensitivity is a multifactorial event that cannot be totally avoided, because it is not exclusively related to the peroxide whitening material (Haywood, 2001)."

The side effects of gingival irritation (GI) and tooth sensitivity (TS) are the most common side effects and affect the patients' compliance to carry out the full course of treatment. Other issues with compliance are the number of applications required to maximise the change of colour. It has

been shown that the teeth whiten to a point rapidly and then plateau and it is difficult to whiten past this point.¹² Indicating an ideal 'end point' (Smart, 2004, comment) for bleaching.

Compliance is the main problem with AHVTB, there have been numerous studies on increasing the concentration of materials so as to decrease the number of applications necessary to reach a satisfactory outcome. Many articles have also looked at using desensitising agents such as potassium nitrate and fluoride

to reduce tooth sensitivity therefore increasing compliance.⁴⁶ The desensitizing agents can be included in the bleaching material or applied separately before or after treatment.

"Tooth sensitivity has been attributed to the penetration of hydrogen peroxide into the pulp chamber. It is speculated that reducing the hydrogen peroxide concentration or the duration of bleach application could reduce the tooth sensitivity but would also likely reduce the tooth whitening as well. Hence other desensitising agents, such as potassium nitrate, have been added to carbamide peroxide bleach formulations in an attempt to decrease the tooth sensitivity experienced by the patient without reducing the concentration of the active bleaching ingredient. (Tam, 2001)"

This study was designed to produce a protocol for the general practitioner that combines known treatment methods and concentrations of materials with known trends, so as to try and decrease the number of applications necessary by using higher concentrations of materials in an incremental approach, also combining the use of active and passive treatment modalities for side effects, so that the main side effects were kept at tolerable levels for the patient within normal ranges of experienced side effects from other literature. The patients were instructed on what to expect and how to treat their own symptoms with the materials given to them, so as to try and improve the outcome by giving the patient enough understanding to control their situation.

MATERIALS AND METHODS

Materials

The materials tested were 3, 7.5 and 9.5% hydrogen peroxide (Pola Day by SDI) and 10, 16 and 22% carbamide peroxide (Pola Night by SDI);

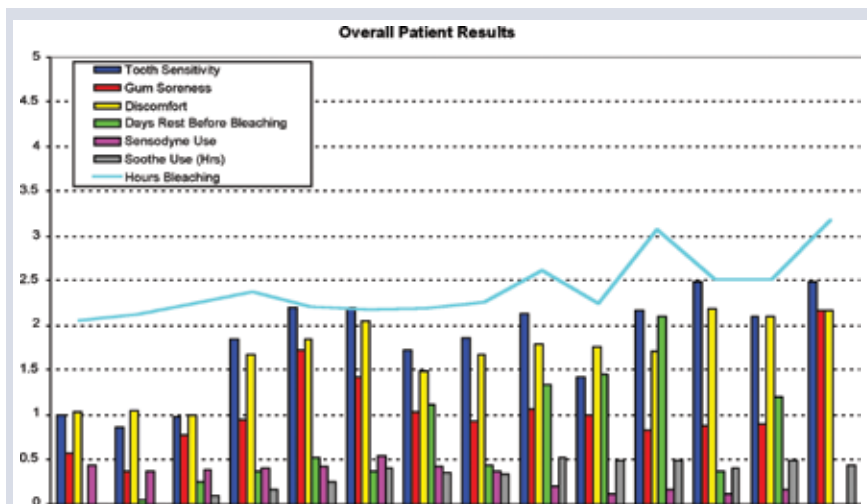


FIGURE 1—Overall Patient Results for; Visual Analogue Scores of Sensitivity Rating and Days Rest, Bleaching Hour(s) , Number of Hour(s) De-sensitiser Used.

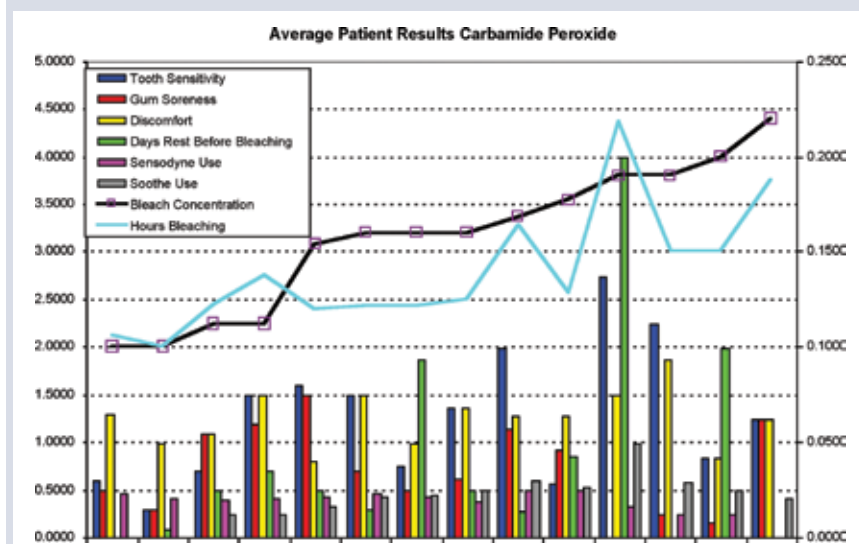


FIGURE 2—Average Patient Results Carbamide Peroxide for; Visual Analog Scores of Sensitivity Rating and Days Rest, Bleaching Hour(s) , Number of Hour(s) De-sensitiser Used.

Constituents:

POLA DAY	POLA NIGHT
3-9.5% Hydrogen peroxide (HP)	10-22.0% wt Carbamide peroxide (CP)
<47% wt Additives	<40% wt Additives
30% wt Glycerol	30% wt Glycerol
0.1%wt Flavour	0.1% wt Flavour
Neutral pH	Neutral pH
20% Water	20% Water

The desensitizing agents used were 6% Potassium Nitrate and 0.10% Sodium Fluoride material in combination (Soothe, SDI) and 3.75% Potassium Chloride and 0.31% Sodium Fluoride (Sensodyne toothpaste, GSK)

SOOTHE (SDI)	SENSODYNE TOOTHPASTE
Potassium Nitrate 6.0%	Potassium Chloride 3.75%
Fluoride ions 0.10%	Sodium Fluoride 0.31% (1400ppm)
Water 89.60%	Triclosan 0.3%
Thickener 4.20%	
Sodium benzoate 0.10%	

Method

The study population were patients from private practice who had expressed an interest in whitening their teeth. Patients that had indicated on medical history forms that they had acatalasaemia or glucose-6-phosphate dehydrogenase deficiency (G6PD), were not included in the study population. The ages

TABLE 1

Overall Patient Average.

	DAYS REST BEFORE BLEACHING	BLEACHING HOURS	BLEACH CONCENTRATION (%)	TOOTH SENSITIVITY (VAS)	GUM SORENESS (VAS)	DISCOMFORT (VAS)	SENSODYNE HOURS	SOOTHE HOURS
Application 1	0.0000	2.0395	0.0668	1.0000	0.5789	1.0421	0.4475	0.0000
Application 2	0.0526	2.1053	0.0668	0.8684	0.3684	1.0526	0.3773	0.0000
Application 3	0.2632	2.2237	0.0732	0.9895	0.7895	1.0000	0.3993	0.1000
Application 4	0.3684	2.3684	0.0803	1.8421	0.9474	1.6842	0.4100	0.1667
Application 5	0.5263	2.1974	0.1166	2.2105	1.7368	1.8421	0.4223	0.2500
Application 6	0.3684	2.1711	0.1208	2.2105	1.4211	2.0526	0.5413	0.4100
Application 7	1.1176	2.1765	0.1162	1.7353	1.0294	1.5000	0.4236	0.3538
Application 8	0.4375	2.2500	0.1188	1.8750	0.9375	1.6875	0.3750	0.3333
Application 9	1.3333	2.6000	0.1227	2.1333	1.0667	1.8000	0.2000	0.5250
Application 10	1.4667	2.2333	0.1267	1.4333	1.0000	1.7667	0.1250	0.5000
Application 11	2.1111	3.0556	0.1306	2.1667	0.8333	1.7222	0.1667	0.5000
Application 12	0.3750	2.5000	0.1425	2.5000	0.8750	2.1875	0.1250	0.4150
Application 13	1.2000	2.5000	0.1580	2.1000	0.9000	2.1000	0.1667	0.5000
Application 14	0.0000	3.1667	0.1783	2.5000	2.1667	2.1667	0.0000	0.4433

TABLE 2

Average Patient Results Carbamide Peroxide

	DAYS REST BEFORE BLEACHING	BLEACHING HOURS	BLEACH CONCENTRATION (%)	TOOTH SENSITIVITY (VAS)	GUM SORENESS (VAS)	DISCOMFORT (VAS)	SENSODYNE HOURS	SOOTHE HOURS
Application 1	0.0000	2.1250	0.1000	0.6000	0.5000	1.3000	0.4622	0.0000
Application 2	0.1000	2.0000	0.1000	0.3000	0.3000	1.0000	0.4067	0.0000
Application 3	0.5000	2.4500	0.1120	0.7000	1.1000	1.1000	0.3950	0.2500
Application 4	0.7000	2.7500	0.1120	1.5000	1.2000	1.5000	0.4163	0.2500
Application 5	0.5000	2.4000	0.1540	1.6000	1.5000	0.8000	0.4263	0.3333
Application 6	0.3000	2.4250	0.1600	1.5000	0.7000	1.5000	0.4660	0.4300
Application 7	1.8750	2.4375	0.1600	0.7500	0.5000	1.0000	0.4320	0.4433
Application 8	0.5000	2.5000	0.1600	1.3750	0.6250	1.3750	0.3750	0.5000
Application 9	0.2857	3.2857	0.1686	2.0000	1.1429	1.2857	0.5000	0.6000
Application 10	0.8571	2.5714	0.1771	0.5714	0.9286	1.2857	0.5000	0.5417
Application 11	4.0000	4.3750	0.1900	2.7500	0.0000	1.5000	0.3333	1.0000
Application 12	0.0000	3.0000	0.1900	2.2500	0.2500	1.8750	0.2500	0.5800
Application 13	2.0000	3.0000	0.2000	0.8333	0.1667	0.8333	0.2500	0.5000
Application 14	0.0000	3.7500	0.2200	1.2500	1.2500	1.2500	0.0000	0.4150

The patients were split into two groups one used hydrogen peroxide 3%, 7.5% and 9.5% materials (Pola Day, SDI), the other group used 10%, 16% and 22% carbamide peroxide materials (Pola Night, SDI).

ranged from 25-65. There were 30 patients surveyed, of which 19 filled in their questionnaires properly.

Impressions were taken on patients and soft bleaching trays

were made by an independent lab. The lab was instructed to place reservoirs on all teeth and also not to trim the trays to the gingival margin but to leave the trays approximately 4-5 mm above the gingival margin, so the trays cov-

ered the gums and had enough clearance material so as not to press into the gum while seated.

The patients were instructed on the use of the materials and given an instruction sheet (Refer to Appendix One). The instructions verbally given to the patients were to apply a small amount of the material into the trays of approximately a quarter a pea size amount. Place this amount in each tooth space on the front surface of the trays. The patients were instructed that if they were using half to three-quarters of the tube for both upper and lower trays they were using approximately the right amount of material. The patients were to seat the trays and wipe away excess material and then wear the trays for approximately 2 hours, then remove the trays rinse mouth and trays out, and then place one of the desensitising agents into the trays for another half an hour. Then remove the trays wait at least another half an hour then clean the teeth.

The patients were split into two groups one used hydrogen peroxide 3%, 7.5% and 9.5% materials (Pola Day, SDI), the other group used 10%, 16% and 22% carbamide peroxide materials (Pola Night, SDI).

Order of bleaching materials hydrogen peroxide

1. For the first 4 applications of the whitening agent, please use the 3% whitening material and Sensodyne toothpaste.
2. For the next 6 applications please use the 7.5% whitening

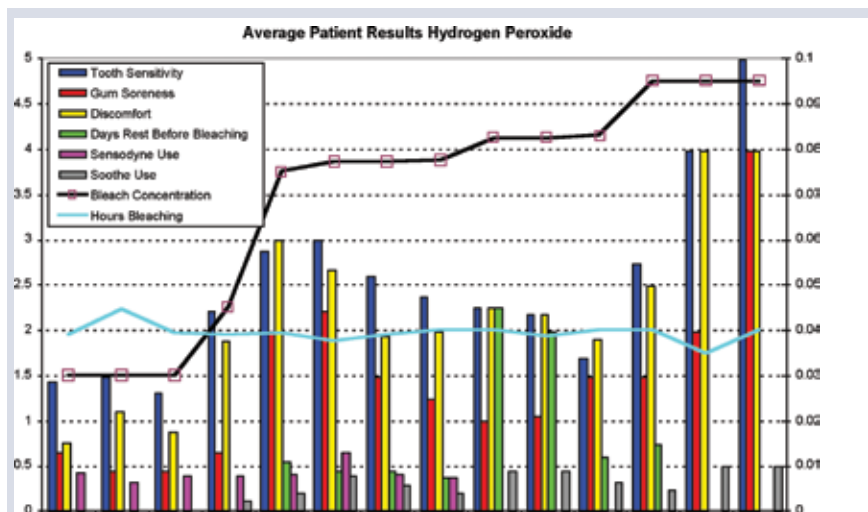


FIGURE 3—Average Patient Results Hydrogen Peroxide for; Visual Analog Scores of Sensitivity Rating and Days Rest, Bleaching Hour(s), Number of Hour(s) Desensitiser Used.

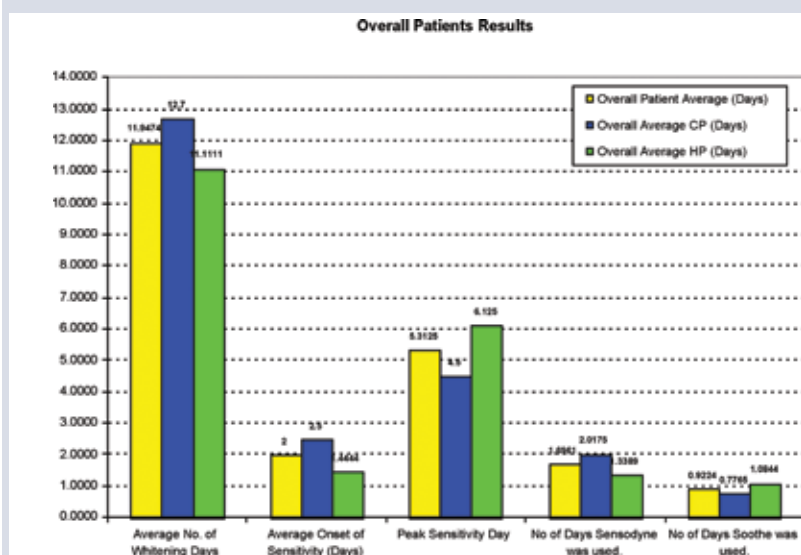


FIGURE 4—Results for; Average Number of Whitening Days, Average Onset of Sensitivity, Peak Sensitivity Day, Number of Days Sensodyne Used and Number of Days Soothe Used.

TABLE 3

Average Patient Results Hydrogen Peroxide.

	DAYS REST BEFORE BLEACHING	BLEACHING HOURS	BLEACH CONCENTRATION (%)	TOOTH SENSITIVITY (VAS)	GUM SORENESS (VAS)	DISCOMFORT (VAS)	SENSODYNE HOURS	SOOTHE HOURS
Application 1	0.0000	1.9444	0.0300	1.4444	0.6667	0.7556	0.4286	0.0000
Application 2	0.0000	2.2222	0.0300	1.5000	0.4444	1.1111	0.3333	0.0000
Application 3	0.0000	1.9722	0.0300	1.3111	0.4444	0.8889	0.4043	0.0000
Application 4	0.0000	1.9444	0.0450	2.2222	0.6667	1.8889	0.4000	0.1250
Application 5	0.5556	1.9722	0.0750	2.8889	2.0000	3.0000	0.4160	0.2000
Application 6	0.4444	1.8889	0.0772	3.0000	2.2222	2.6667	0.6667	0.3929
Application 7	0.4444	1.9444	0.0772	2.6111	1.5000	1.9444	0.4167	0.3000
Application 8	0.3750	2.0000	0.0775	2.3750	1.2500	2.0000	0.3750	0.2000
Application 9	2.2500	2.0000	0.0825	2.2500	1.0000	2.2500	0.0000	0.4500
Application 10	2.0000	1.9375	0.0825	2.1875	1.0625	2.1875	0.0000	0.4583
Application 11	0.6000	2.0000	0.0830	1.7000	1.5000	1.9000	0.0000	0.3333
Application 12	0.7500	2.0000	0.0950	2.7500	1.5000	2.5000	0.0000	0.2500
Application 13	0.0000	1.7500	0.0950	4.0000	2.0000	4.0000	0.0000	0.5000
Application 14	0.0000	2.0000	0.0950	5.0000	4.0000	4.0000	0.0000	0.5000

material and Soothe or Sensodyne depending on how sore or sensitive your teeth are. The Soothe material is a stronger desensitiser.

- If you require a lighter colour the next 4 applications can be made with the 9.5% whitening material with the use of Soothe.

Order of bleaching materials carbamide peroxide

- For the first 4 applications of the whitening agent, please use the 10% whitening material and Sensodyne toothpaste
- For the next 6 applications please use the 16% whitening material and Soothe or Sensodyne depending on how sore or sensitive your teeth are. The Soothe material is a stronger desensitiser.
- If you require a lighter colour the next 4 applications can be made with the 22% whitening material with the use of Soothe.

The patients were also instructed that they would most likely experience some tooth sensitivity and gum irritation and that if it is only mild then they should use the Sensodyne toothpaste in the trays after whitening for half an hour, if the tooth sensitivity or

TABLE 4

Results for; Average Number of Whitening Days, Average Onset of Sensitivity, Peak Sensitivity Day, Number of Days Sensodyne Used and Numbr of Days Soothe Used.

	OVERALL AVERAGE	AVERAGE CP	AVERAGE HP
Average No. of Whitening Days	11.9474	12.7	11.1111
Average Onset of Sensitivity (Days)	2	2.5	1.4444
Peak Sensitivity Day	5.3125	4.5	6.125
No. of Yes Answers to;	44.5%	38.2%	51.6%
Did you feel sensitivity today (%)			
No. of Yes Answers to; Did you feel	20.0%	17.0%	23.3%
gum soreness today (%)			
Average Mild Sensitivity (%)	66.8%	57.3%	77.4%
Average Moderate Sensitivity (%)	4.8%	1.6%	8.4%
Average Severe Sensitivity (%)	3.3%	4.5%	2.0%
Average No Sensitivity (%)	25.3%	36.7%	12.7%
No of Days Sensodyne was used.	1.6961	2.0175	1.3389
No of Days Soothe was used.	0.9224	0.7765	1.0844

gum soreness was of a moderate level they could choose between the Soothe or Sensodyne toothpaste to use within the trays for half an hour after whitening. The patients were instructed that if the tooth sensitivity or gum soreness was greater than moderate and becoming uncomfortable then they should take a days break and/or use the Soothe material without whitening for 2 hours in the trays. It was mentioned to the patients that it was unnecessary to bleach everyday, but that it was preferred that they whiten for a few days and take a days rest then whiten again for a

few days and then rest. The patients were also instructed that if the sensitivity became severe then they were to stop bleaching and contact the researcher. It was explained to the patients they were in control of their symptoms and instructed how to use the materials when necessary or take time off from the whitening procedure, therefore hopefully making the patient more comfortable with the procedure and more compliant.

The patients were given questionnaires to fill one out everyday, these questionnaires involved yes/

no questions and three visual analogue scales (VAS) of 10cm's with 10 increments from 0-10, for the patients to rate their tooth sensitivity, gum soreness and overall discomfort levels on 46. The patients were also asked if they would like to make any other comments as well. (Refer to Appendix One)

The patients were reviewed at the approximately 7 days and once the patient was satisfied with the result, or if the patient was experiencing above normal tooth sensitivity or gum soreness.

The patients were private practice patients that expressed a wish to whiten their teeth.

RESULTS

The Patients were instructed to fill out a questionnaire with a series of yes / no answers and three Visual Analogue Scales (VAS)46. Results are presented in the following graphs and tables.

DISCUSSION

The study was designed to try and combine previously recognised trends in the literature in a clinical protocol that the general practitioner can follow so as to try and improve patient compliance by reducing the number of applications of the material needed to reach a satisfactory end point. The study combined the use of desensitising materials and known methods for reducing common side effects, of tooth sensitivity (TS) and gingival irritation (GI), with the incremental increase in concentration of the peroxide materials so as to try and limit the number of applications of bleaching materials necessary whilst maintaining the side effects, reported in previous studies, within normal intensity and frequency gradients. The study also tried to enable the patients to make informed decisions about how to treat their own symptoms, this is an at home monitored system where the patient is in complete control of the treatment outcome, so by hopefully improving the patients awareness of available treatment protocols for the main side effects and giving the patients access to the necessary treatment options for the main side effects, it was hoped that this would improve patient compliance and the overall treatment outcome.

The patients were private practice patients that expressed a wish to whiten their teeth. This was due to the fact the study was trying to generate information to guide the private practitioner in the normal general practice environment. Unfortunately this also meant that at times it was hard to get patients

TABLE 5

Results for No. of Yes Answers to; Did You Feel Sensitivity Today? Did You Feel Gum Soreness Today? Also Average Sensitivity Ratings Breakdown for Groupings Mild, Moderate and Severe.

	OVERALL AVERAGE	AVERAGE CP	AVERAGE HP
No. of Yes Answers to; Did you feel sensitivity today (%)	44.5%	38.2%	51.6%
No. of Yes Answers to; Did you feel gum soreness today (%)	20.0%	17.0%	23.3%
Average Mild Sensitivity (%)	66.8%	57.3%	77.4%
Average Moderate Sensitivity (%)	4.8%	1.6%	8.4%
Average Severe Sensitivity (%)	3.3%	4.5%	2.0%
Average No Sensitivity (%)	25.3%	36.7%	12.7%
No of Days Sensodyne was used.	1.6961	2.0175	1.3389
No of Days Soothe was used.	0.9224	0.7765	1.0844
Average Time Sensodyne Used (Hrs)	0.4436	0.4777	0.4057
Average Time Soothe Used (Hrs)	0.4434	0.4715	0.4120
Average Mild Sensitivity When Rating 1 or Lower Removed (%)	36.4%	25.4%	48.8%
Average Mild Gum Irritation (%)	50.7%	45%	57.2%
Average Moderate Gum Irritation (%)	2.7%	2.7%	2.8%
Average Severe Gum Irritation (%)	0.7%	0.3%	1.1%
Average Mild Gum Irritation When 1 or Lower Removed (%)	16.9%	12.6%	21.7%

TABLE 6

Results for; Average Sensodyne Use (Hrs) and Average Soothe Use (Hrs)

	OVERALL AVERAGE	AVERAGE CP	AVERAGE HP
Average Time Sensodyne Used (Hrs)	0.4436	0.4777	0.4057
Average Time Soothe Used (Hrs)	0.4434	0.4715	0.4120

TABLE 7

Results for Average Number of Days Use of Desensitisers

	OVERALL AVERAGE	AVERAGE CP	AVERAGE HP
Continuous Applications	11	7	4
1 Application	1	0	1
2-5 Applications (not continuous)	1	0	1
5-10 Applications (not continuous)	5	3	2

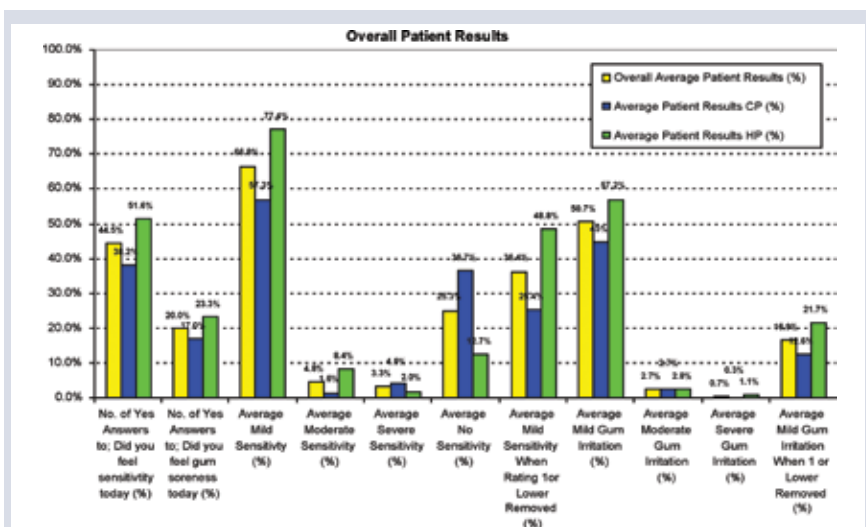


FIGURE 5—Results for No. of Yes Answers to: Did You Feel Sensitivity Today? Did You Feel Gum Soreness Today? Also Average Sensitivity Ratings Breakdown for Groupings Mild, Moderate and Severe.

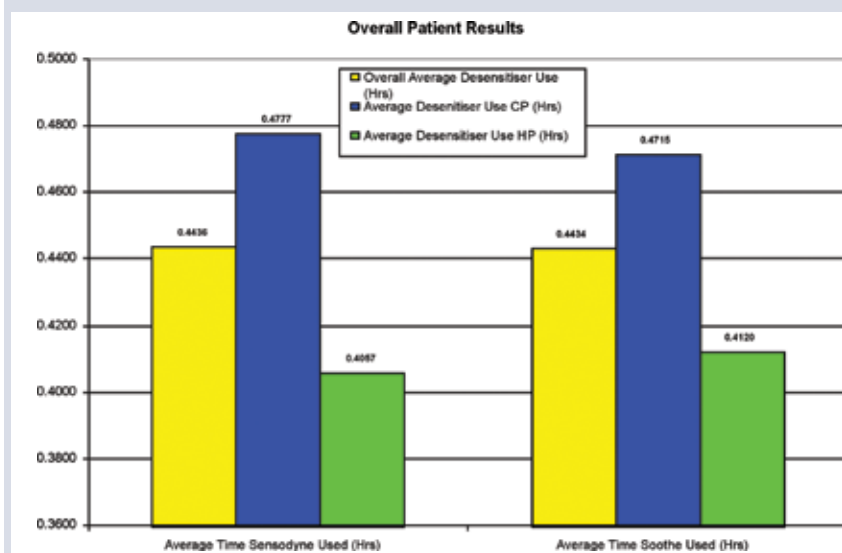


FIGURE 6—Results for Average Sensodyne Use (Hrs) and Average Soothe Use (Hrs).

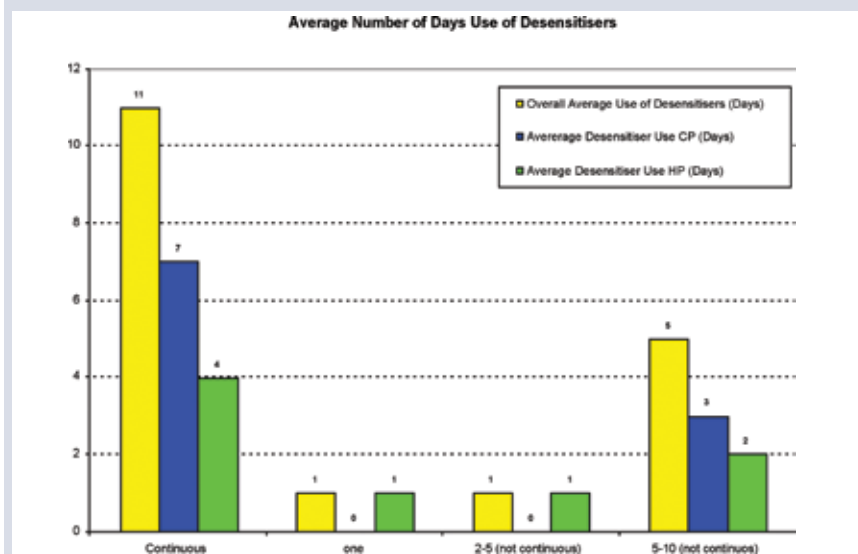


FIGURE 7—Results for Average Number of Days Use of Desensitisers.

to fill in their forms properly and compliance has even more of a negative impact on the outcomes, but it also meant that patients were more expectant of results and less willing to endure the main side effects if they occurred, so therefore more willing to use the treatment methods available to them whilst being more honest with filling in the questionnaires if they were completed.

CONCLUSION

The trend indicates that by incrementally increasing the concentrations of materials and by educating the patients to the active and passive treatment modalities available to the patient for the main side effects, of tooth sensitivity and gingival irritation, that an acceptable result can be achieved for both patient and practitioner in the least number of applications necessary whilst maintaining the main side effects within or below the normal levels achieved in other literature. Therefore, improving patient compliance and the overall satisfaction level of the process.

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