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EVALUATION OF HALITOSIS IN PATIENTS AFTER TREATMENT WITH PHOTODYNAMIC THERAPY: A SYSTEMATIC REVIEW

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ABSTRACT

Background: Halitosis is a common problem many individuals face regularly and requires a convenient treatment method. Photodynamic therapy, which is currently used as a treatment method for targeted cancer therapy, can be used as a treatment modality after required modifications.

Aim: To evaluate the effectiveness of photodynamic therapy in reducing halitosis or oral malodor in an individual.

Methods: PubMed, Cochrane, Science Direct, Wiley, Prospero, Grey literature were used as a source for literature search. Of the 384 articles screened, 204 were full-text articles assessed for eligibility, and 4 were considered for the qualitative analysis. PRISMA guidelines were followed while framing the review. In addition, 4 randomized controlled trials were included for the review process.

Results: The outcomes revealed that photodynamic therapy could reduce the amount of volatile Sulphur compounds formed in the oral cavity to a sufficient extent for its use as a method to reduce halitosis.

Conclusion: Photodynamic therapy was found to be successful in reducing oral malodor and can be used as a mode of treatment for halitosis.

Keywords*: Photodynamic therapy, Halitosis, Volatile Sulphur compounds, Treatment*

1. INTRODUCTION

Bad breath is a very common problem faced by a large portion of the population on a daily basis. It is also an issue that people normally hesitate to mention to their dentists or are unaware that it is a condition medically known as halitosis.[1]

In the developed world, around 8-50% acknowledge that they do have this problem and complain of multiple recurrences of this condition. Such individuals notice the presence of malodor coming from their mouth while speaking, which can cause social awkwardness and embarrassment.[2]

Such individuals may seek treatment from their dentists to avoid embarrassment and get rid of the malodor. Currently, not many efficient treatment options are available for such conditions and mostly depend on maintaining good oral hygiene. [3,4]

Halitosis is caused due to volatile compounds formed in the oral cavity, which enter the surrounding environment causing malodor. These are normally volatile compounds containing Sulphur which can thus be used as a marker for detecting and recording the severity of this condition in individuals.[5,6]

A certain amount of halitosis is common in individuals after sleeping since the bacteria present in the oral cavity produce gases responsible for malodor production. Halitosis at other times is not normal and requires treatment. [7]

For thousands of years, therapeutic properties of light have been noted but only in recent times has light been used as a treatment modality called photodynamic therapy. It consists of irradiating lights of particular frequencies to cause required changes in biological structures.[8,9]

Currently, photodynamic therapy is mainly used for the treatment of cancers. It is a clinically approved procedure and can have selective cytotoxicity to only cells which show a malignant potential. It may be accompanied by a tumour localizing agent, which may require light of a particular wavelength

for its activation. The photosensitizer, given by intravenous injection, when activated by required light, can increase the sensitivity of treatment to be more towards cells with malignant potential while selectively sparing normal cells.[10,11,12,13]

It is proposed that this photodynamic therapy under reduced strength and after modification as required can be an effective treatment option for halitosis as it has the potential to reduce the amount of volatile Sulphur compounds formed in the oral cavity and destroy the bacteria causing its formation to a certain extent.[14,15] The present study aims to evaluate the effectiveness of photodynamic therapy in reducing halitosis or oral malodor in an individual.

2. MATERIALS AND DESIGN

Study design:

A systematic review of randomized controlled trials.Randomized controlled trials and clinical studies with interventions were included in the study.

Eligibility Criteria:

INCLUSION

- Randomized controlled trials and pilot studies till the recent update.
- Full-text articles available in the search engine mentioned in the search strategy were included.
- Studies in which halitosis was measured in patients who have undergone photodynamic therapy.

EXCLUSION

- Non-randomized studies

Search strategy: Published results on Evaluation of halitosis in patients after treatment with photodynamic therapy, these original articles and research papers in databases were considered, such as:

PMC, Sciencedirect, PubMed, Cochrane, Wiley. To obtain the articles using mesh representations, a literature search to collect relevant data was performed using MeSH terms “halitosis” and “photodynamic therapy”.

Search engine:

- PMC
- Science Direct
- PubMed
- Cochrane
- Wiley
- Prospero
- Grey literature

3. RESULTS

The search yielded 384 records, and full-text articles were independently assessed. Figure 1 depicts a flow diagram of the reports that identified; duplicates removed, screened, excluded and were assessed for their eligibility before being included in the review.

FLOW DIAGRAM SHOWING NUMBER OF STUDIES IDENTIFIED, SCREENED, ASSESSED FOR ELIGIBILITY AND INCLUDED FOR SYSTEMATIC REVIEW

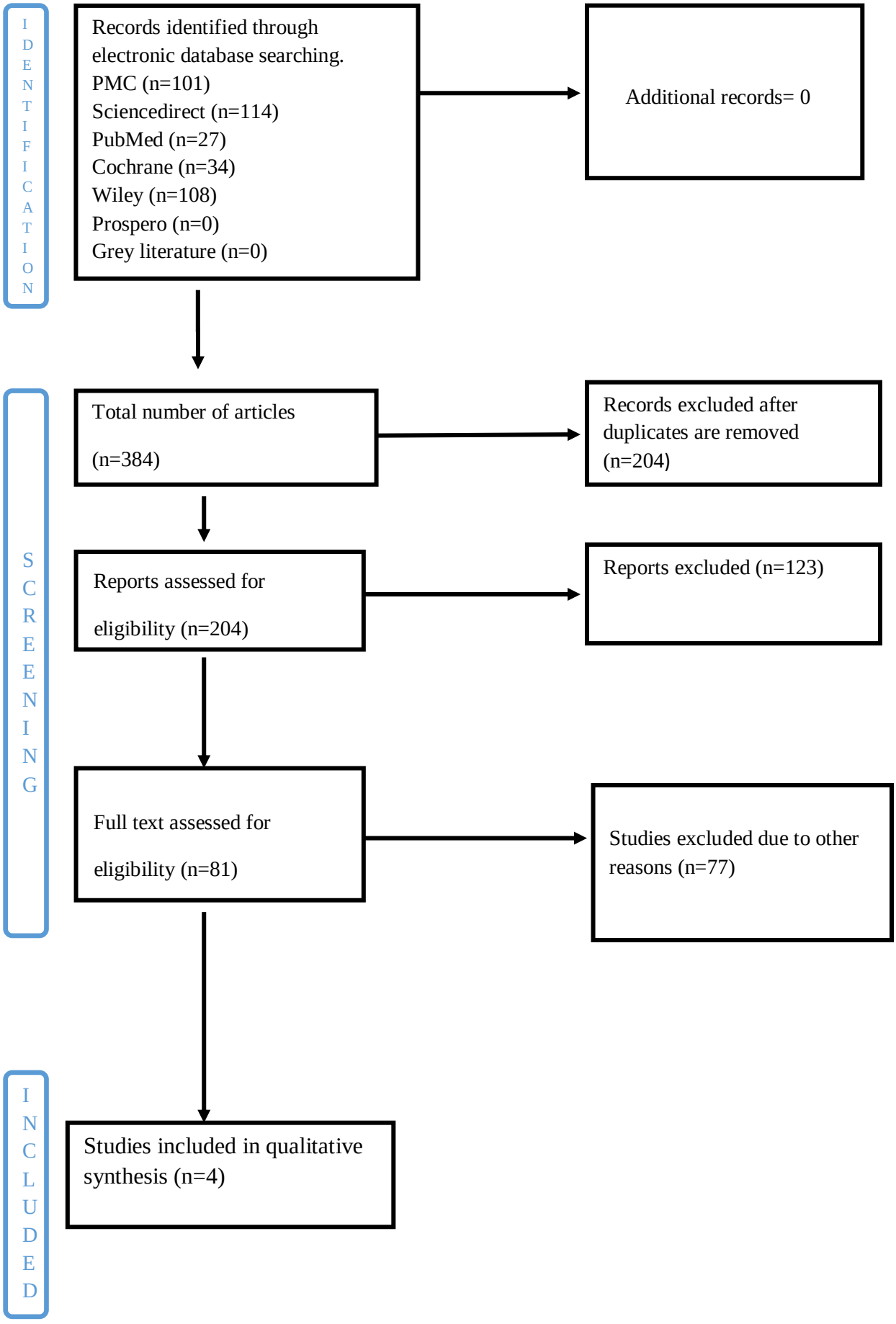

TABLE 1: CHARACTERISTICS OF THE INTERVENTIONS IN THE INCLUDED STUDIES

AUTHOR NAME	YEAR	SAMPLE SIZE	PATIENT CHARACTERISTICS	DURATION	NUMBER (CASE /CONTROL)
Lopes et al.[15]	2014	5	Five adolescent subjects aged 14 to 16 years were evaluated.	-	Test group – 5 individuals
Gonçalves et al.[16]	2017	30	Patients with Multiple sclerosis in treatment at the Specialties Clinic School of Medicine and healthy patients, matched in age and gender, for the control group.	-	Group 1: 30 MS patients Group 2: 30 subjects
dos Santos Romero et al[17]	2019	40	Individuals undergoing PDT as a treatment for halitosis and individuals using tongue scraper for the same	3 months	Group 1-treatment with PDT G2-cleaning of the tongue with a tongue scraper
Abdul Aziz Alshahrani et al[18]	2020	45	Forty-five adolescents undergoing orthodontic treatment and showing signs of halitosis were equally randomized into three groups	3 months	Group – I: Treatment through photodynamic therapy on the dorsum of tongue Group – II: Treatment with the help of tongue scrappers Group – III: Treatment with the help of tongue scraper and adjunctive photodynamic therapy.

Table 1 depicts the Characteristics of the interventions in the studies that were included . Among all 4 studies, the amount of volatile Sulphur compounds were compared before and after the treatment. But the sample size, age of the population and the duration of the were varied individually during the study. In addition, one of the trials were performed among healthy adolescents and one study among subjects having multiple sclerosis

TABLE 2: OUTCOME DATA AS REPORTED IN INCLUDED STUDIES

AUTHOR NAME	YEAR	EFFECT MEASURE	RESULTS
Lopes RG et al.[15]	2014	Gas chromatography	A significant reduction of 26.6 ppb is seen after treatment in the subjects.
Gonçalves et al[16]	2017	OralchromaTM	Patients with Multiple sclerosis generally have higher levels of SH2 compounds when compared to the control group, but after the PDT, both groups significantly reduced the levels to under the halitosis threshold. The treatment with scraping a PDT was effective in the immediate reduction of halitosis in both groups

dos Santos Romero et al[17]	2019	Measuring volatile sulfur compounds using gas chromatography	After treatment, a significant reduction in total volatile sulfur compounds was found in all groups, with the largest reduction found in Group 2 (tongue scraper and photodynamic therapy). Moreover, a significant difference was found between treatment with photodynamic therapy and a tongue scraper alone.
Abdul Aziz Alshahrani et al[18]	2020	Gas chromatography and estimation of oral malodour with a cysteine challenge	Treatment with the respective therapeutic modalities showed a significant difference was seen among groups after 2-weeks. Group III showed the highest amount of reduction in H_2S concentration at final breath analysis after 2 weeks as compared to group I and group II.

Table 2 shows the outcome data after photodynamic therapy in the included studies. There was a progressive decrease in the amount of volatile Sulphur compounds formed in the subjects when compared to the control group from baseline till the end of the intervention period in the studies. Table 3 shows the bias assessment of the included studies.

TABLE 3: BIAS ASSESSMENT AS INCLUDED IN THE STUDIES

AUTHOR NAME/ YEAR	RANDOM SEQUENCE GENERATION	ALLOCATION CONCEALMENT	BLINDING OF OUTCOME	INCOMPLETE OUTCOME DATA	BLINDING OF PARTICIPANTS AND PERSONNEL	SELECTIVE REPORTING
Lopes RG et al., 2014	+	-	-	**?**	-	**?**
Gonçalves et al., 2017	+	+	+	+	+	**?**
dos Santos Romero et al, 2019	+	-	-	+	-	+
Abdul Aziz Alshahrani et al, 2020	+	+	+	-	+	+

+ = low risk of bias; - = high risk of bias; ? = unclear risk of bias

4. DISCUSSION

Halitosis is a problem many individuals face regularly and can cause social awkwardness for such individuals. A proper treatment protocol is thus a necessity for such individuals. Photodynamic therapy can help such individuals and be implemented as a proper treatment modality for halitosis.

The systematic review found photodynamic therapy to be a helpful factor in reducing the amount of volatile Sulphur compounds, which are essential markers for the intensity of foul smell produced in an individual's oral cavity, causing halitosis. All of the trials in consideration have shown positive results and encourage the use of photodynamic therapy to reduce halitosis.Lopes RG et al. studied the benefits of photodynamic therapy in adolescent individuals using gas chromatography as a means of determining the amount of volatile sulphur compounds as a marker of halitosis. While it was determined that photodynamic therapy does, in fact, help in reducing halitosis, certain modifications were required in the method of irradiation of patients during the procedure to make the patients more comfortable and encourage more individuals to use this treatment option. Patients should also be enlightened on the benefits of regular tongue cleaning in reducing halitosis.[15]

Gonçalves et al. reported a significant reduction in the amount of volatile sulphur compounds in subjects suffering from multiple sclerosis, who initially had more volatile sulphur compounds than healthy subjects after photodynamic therapy. This is a direct indication that photodynamic therapy does, in fact, reduce the amount of volatile sulphur compounds in the oral cavity, which signifies a reduction in the occurrence of halitosis.[16]

dos Santos Romero et al., in their trial in 2018, divided their subjects into two groups, which included a group of individuals undergoing photodynamic therapy to reduce halitosis while the subjects in the other group used tongue scraper as a means of reducing halitosis. Both methods successfully reduced halitosis to an extent, with photodynamic therapy having more success comparatively and a combination of both methods was determined to be the best treatment modality.[17]

Abdul Aziz Alshahrani et al. studied the benefits of photodynamic therapy in reducing halitosis in patients undergoing orthodontic therapy. 45 subjects who underwent this treatment showed a positive response to the therapy to reduce the amount of volatile sulphur compounds. When combined with tongue scraping, the benefits were much more significant. The authors also mentioned that further studies were required to properly implement the treatment method while keeping the cost and potential side effects in mind.[18]

There is conclusive evidence that photodynamic therapy can effectively reduce the amount of volatile sulphur compounds in the oral cavity and thus the occurrence of halitosis in affected individuals. When combined with tongue scraping, it can become a very successful method in treating halitosis.

5. CONCLUSION

Photodynamic therapy was found to be successful in reducing oral malodor and can be used as a mode of treatment for halitosis after further optimization.

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