

学位論文の内容の要旨

論文提出者氏名	Ei Ei Aung
論文審査担当者	主査 木下 淳博 副査 品田 佳世子、荒川 真一
論文題目	Effectiveness of three oral hygiene regimens on oral malodor reduction: a randomized clinical trial
<p>(論文内容の要旨)</p> <p>Background</p> <p>Oral malodor, also known as bad breath, is a nuisance problem for many people around the world. Previous studies have reported that about 30 to 50% of the population possess with a problem of bad breath. The main causative substances of oral malodor are volatile sulfur compounds (VSCs) produced by bacteria and protein putrefaction of sulfur-containing amino acids. There are various etiological factors for oral malodor, but intra-oral sources, such as periodontal diseases, tongue coating, poor oral hygiene, and dry mouth are the main causes of increased levels of VSCs. Among these, the primary source of VSCs production is a coating on the dorsum of the tongue.</p> <p>Both chemical and mechanical methods are available for controlling oral malodor. Many studies of various mouth rinse applications and tongue cleaning procedures have been conducted. However, few studies have compared the effect of simultaneous chemical and mechanical procedures on the reduction of VSCs in subjects with oral malodor. Therefore, this study aims to assess the effects of different oral hygiene procedures, i.e., tooth brushing, mouth washing, and tongue cleaning, alone and in combination, on the reduction of VSCs in subjects with oral malodor.</p> <p>Methods</p> <p>This clinical study was conducted in Yangon, Myanmar, from September to October of 2013. Forty-eight male monk volunteers were screened to assess whether they matched the inclusion criteria and total VSCs more than the threshold level of 250 ppb measured by Breathtron[®]. Eighteen of these subjects were excluded because they did not match the criteria. After the screening, the final subjects used for this study were 30 males aged 18 to 30 years (mean age: 20.2 ± 2.8 years).</p> <p>This study was carried out with a randomized, single blind and 5-week parallel design. Subjects were randomly divided into two groups (A and B) of 15 subjects each. Both groups were instructed to brush their teeth with a scrubbing method in the first week. For the next 3 weeks, in addition to tooth brushing; group A used 12 mL of chlorine dioxide (ClO₂) Fresh[®] mouthwash for 30 seconds twice daily, and group B performed tongue cleaning twice daily with a small toothbrush. Following the above, both groups</p>	

practiced all three oral hygiene regimens: tooth brushing, mouth washing, and tongue cleaning for the last 1 week.

Oral malodor was evaluated during the day from 2 pm to 5 pm. Subjects were asked to refrain from drinking and eating as well as oral hygiene practices at least 2 hours before the measurement. The amount of total VSCs was measured using Breathtron® and the level of total VSCs of more than 250 ppb were categorized as having oral malodor.

Following the oral malodor evaluation, dentition status [number of decayed teeth (DT), number of filled teeth (FT), and number of missing teeth (MT) excluding third molars] was examined. The amount of plaque was evaluated with the debris index (DI) of the Oral Hygiene Index (OHI). The highest score for each tooth was recorded. Gingival bleeding on probing (BOP) was recorded if bleeding was detected after examination with a periodontal probe. Tongue coating was evaluated by a modified Winkel tongue-coating index. The tongue dorsum was divided into nine areas and tongue coating was evaluated for all nine areas with a score from 0 to 2. The tongue coating score was calculated by adding the scores of all nine areas, resulting in a possible range from 0 to 18. The flow rate of saliva (mL/min) was calculated, and the saliva pH level was measured with a bromothymol blue test paper. Total VSCs, DI score, BOP and tongue coating were examined at the baseline and weekly during the 5 weeks by a principal examiner who was blinded to the subject's group.

Results

There were no significant differences in any characteristics, including age, total VSCs, present teeth (DT, FT, MT), flow rate and pH of saliva, DI, BOP, and tongue coating between groups A and B at baseline. Compared to the baseline, DI scores were significantly improved in both groups at the first week's examination ($P < 0.01$) and low scores have been maintained at the following weekly examinations. There was no significant difference in DI scores between groups A and B at any examination period. In comparison with the baseline, BOP was significantly decreased at the first week's examination in both groups ($P < 0.05$). At the following weekly examinations, BOP has been maintained low values in both groups. There was no significant difference in BOP between groups A and B at any examination period. Compared with the baseline, tongue coating score did not change significantly at the first week's examination in either group, but it significantly decreased from that of the second week's examination in both groups ($P < 0.05$). Group B had significantly lower tongue coating scores than group A at the second and fourth weeks. At the third week, group B had lower tongue coating score than group A but there was no significant difference between the two groups. At the fifth week, the tongue coating score in both groups was its lowest, and there was no significant difference in the tongue coating score between groups A and B.

As for oral malodor, there were no significant reductions of total VSCs at the first week's examination compared to that at baseline in either group. In both groups, the mean values of total VSCs level were above 250 ppb, and there was no significant difference between the two groups. At the second week, total VSCs was significantly decreased from baseline in both group A ($P < 0.01$) and group B ($P < 0.05$). From

the second to the fourth week, both groups indicated significant reductions of total VSCs compared to baseline, and all mean values were lower than 250 ppb. Group A showed significantly lower total VSCs values than group B. At the fifth week, the total VSCs were significantly lower than at baseline and lower than the previous weekly examinations in both groups. There was no significant difference in the total VSCs between the two groups.

Regarding the change of the percentage of the subjects with oral malodor, after one week tooth brushing, more than 50% of the subjects in both groups still had oral malodor. The percentage of subjects with oral malodor in group A was decreased to 6.7% on the second week, and that in group B declined to 20.0% by the fourth week. At the fifth week, no subjects in either group had oral malodor.

Discussion

The current study revealed that tooth brushing alone could not improve the oral malodor, but either mouth washing or tongue cleaning significantly reduced the VSCs. Further, the combination of tooth brushing, mouth washing and tongue cleaning was the most effective regimen for improvement of oral malodor.

ClO₂ mouthwash reduced VSCs significantly and kept the VSCs level low during the study period (as long as 4 weeks in this study). ClO₂ has a powerful oxidative action to change VSCs to non-malodorous products, and the chloride anion exerts bactericidal activity against oral malodor-producing microorganisms. Further, our study found that the amount of tongue coating was significantly reduced when using a ClO₂ mouthwash without tongue cleaning.

A previous study demonstrated that oral malodor of subjects in a tooth-brushing group was more severe than those in a tongue-cleaning plus tooth-brushing group. Tongue coating plays a vital role in the production of VSCs. Adding tongue cleaning to tooth brushing significantly reduced the VSCs as well as the percentage subjects with oral malodor by up to 80% in this study.

Comparison of oral malodor reduction between groups A and B showed that the percentage of subjects with oral malodor quickly declined to 6.7% at the second week's examination in group A. The decrease was more gradual in group B, from 46.7% at the second week to 20% at the fourth week. It was probably because the actions of mouthwash had a prompt effect on oral malodor improvement in group A. On the other hand, the subjects in group B might take time to learn the skills for complete cleaning of the tongue.

This study demonstrated that a combination of chemical and mechanical procedures had the strongest effect on the reduction of VSCs. One former study reported that using mouthwash was essential for additional reduction of oral malodor if the subject still had oral malodor after tooth and tongue brushing. Our findings agree with that result, in that mechanical tongue cleaning without using any kind of chemical agents could reduce the VSCs but was not more effective than combining methods. This suggests that the chemical action of a mouthwash can help reduce oral malodor by reaching areas that are difficult to access by tongue cleaning. The results of this study could contribute to the formulation of appropriate preventive strategies against oral malodor.

Conclusions

The results of this study indicate that both mouth washing, as a chemical method, and tongue cleaning, as a mechanical method, significantly reduce oral malodor. However, combining both mechanical and chemical regimens is the most effective method for the reduction of VSCs in subjects with oral malodor.

和文による要約

本研究の目的は3種類の口腔衛生手法による口臭軽減効果を検討することである。男性30名を無作為にA、Bの2群に分けて、ブラッシング、ClO₂による洗口、舌清掃を組み合わせた臨床試験を実施した。口臭の有無はブレストロン®による揮発性硫黄化合物（VSC）の測定で判定した。

2群間のベースライン時のう蝕、歯周組織の状況、口腔清掃状態に有意差は認められなかった。最初の1週間は両群ともにスクラッピング法でブラッシング(2回/日)を行ったが、VSCの有意な減少はみられなかった。2~4週目は歯磨きに加えて、A群はClO₂による洗口(2回/日)を、B群は舌清掃(2回/日)を行ったが、両群ともベースラインと比較してVSCが有意に減少した。両群ともにVSCが最も低下したのは、3種類の口腔衛生手法すべてを実施した5週目であった。ベースライン時に100%であった口臭を有する者の割合は、A群は2週目で6.7%まで急減した。一方、B群では2週目47%、3週目40%、4週目20%と徐々に減少した。両群ともに5週目には0になった。

本研究により、口臭は歯磨きだけで低下させることは困難であるが、ClO₂による洗口や舌清掃を加えると効果的に軽減できることが判明した。口臭低下に即効性があったClO₂と比較して舌清掃の効果は緩やかであったが、適切な清掃方法の取得に時間を要することがその理由と考えられた。本研究では3種類の口腔衛生手法を同時に実施すると口臭軽減効果が最も大きいことが判明し、口臭治療を行ううえで有用なガイドラインになることが示唆された。

論文審査の要旨および担当者

報 告 番 号	甲 第 4977 号	Ei Ei Aung
論文審査担当者	主 査 木下 淳博 副 査 品田 佳世子、荒川 真一	
論 文 題 目	Effectiveness of three oral hygiene regimens on oral malodor reduction: a randomized clinical trial	
<p>(論文審査の要旨)</p> <p>口臭の存在は、社会生活において良好な人間関係を築くうえで障害となる。口臭は多因子性疾患であるが、その90%以上は歯周病、舌苔、口腔清掃不良、口腔乾燥症などの歯科領域の疾患・異常が原因であると報告されている。したがって、歯科医師が正確な診断に基づき、適切な治療や予防法を提供することが必要である。これまでの研究により、口臭の原因物質は主に硫化水素、メチルメルカプタン、ジメチルサルファイド等の揮発性硫黄化合物（VSC）であることが判明している。口臭臨床の現場では患者に対して最初に口腔衛生手法の指導が行われている。しかし、これまで化学的および機械的口腔衛生手法の口臭改善効果を比較検討した研究はほとんど実施されていない。</p> <p>そこで、Ei Ei Aung は3種類の口腔衛生手法による口臭改善効果を検証するために本研究を実施した。具体的には、ボランティアの男性30名（平均年齢20.2歳）を対象とし、無作為に2群（A群とB群）に分けて5週間の臨床試験を実施した。最初の1週間は両群ともスクラビング法でブラッシングを行った。次の3週間はブラッシングに加え、A群は亜塩素酸含有洗口液（ClO₂Fresh®）12mLを用いて1日2回30秒間含嗽を、B群は1日2回舌清掃を行った。最後の1週間は両群ともブラッシング、亜塩素酸含有洗口液による含嗽、舌清掃の3種類の口腔衛生手法すべてを行った。ベースライン及びその後1週間ごとに、ブレストロン®を用いたVSCの測定と口腔保健状況の評価を行い、結果を比較検討した。</p> <p>本研究はランダム化比較試験を採用しており、Ei Ei Aungがこのデザインを用いて臨床研究を遂行したことは対象選択の優れた点も含めて高く評価できる。通常、洗口剤等の臨床試験は1週間の短期効果をみる研究がほとんどであり、5週間にわたって口臭改善の効果を調べた本研究は新規性があり、その意義は大きい。評価には国際的に妥当性が確認されている指標や口臭測定法が使用されており、科学的な統計解析が行われ、得られた結果に対する考察も適切に行われている。</p> <p>本研究によって、以下のことが明らかになった。</p> <ol style="list-style-type: none"> 1. 歯垢付着と歯肉出血は、ベースラインと比較して1週間のブラッシングでA、B群ともに有意に改善し、その後も低い値を保った。舌苔付着は、ベースライン時に比較してブラッシングでは両群とも有意な減少は認められなかったが、亜塩素酸含有洗口液による含嗽あるいは舌清掃を追加することにより両群とも有意に減少した。2週目と4週目の舌苔付着はB群がA群より有意に低値を示した。3種類の口腔衛生手法すべてを実施した後には舌苔付 		

着は最も低い値を示し、両群間に有意な差は認められなかった。

2. VSC は、1 週間のブラッシングではベースラインと比較して両群とも有意な減少はみられなかった。2～4 週目に洗口や舌清掃を追加して実施することにより、VSC の有意な減少が認められた。また、A 群は B 群に比較し有意に低い値を示した。両群とも VSC が最も減少したのは、3 種類の口腔衛生手法すべてを実施した後であった。
3. 口臭を有する者の割合は、1 週間のブラッシング後では両群とも 50%以上あった。洗口を実施した A 群では 2 週目に 6.7%に減少した。一方、舌清掃を行った B 群では口臭を有する者の割合は徐々に減少し、2 週目で 46.7%、4 週目で 20%であった。3 種類の口腔衛生手法すべてを実施した後は、口臭を有する者の割合は両群ともゼロになった。

以上の結果から、ブラッシングだけで口臭を改善させることはできないが、亜塩素酸含有洗口液での含嗽や舌清掃を加えることで口臭は有意に改善することが判明した。洗口と舌清掃を比較すると、口臭改善効果は洗口では即効性がみられたが、舌清掃による効果は緩やかであった。この理由として舌清掃の適切な手法を習得するには時間を要するためと考えられた。また、3 種類の口腔衛生手法をすべて実施することが、口臭改善に最も効果があることが示唆された。

口臭は多くの人を悩ましている問題であり、人間関係や社会生活に弊害が及ぶことで QOL の低下をきたす場合もある。本研究の成果は、今後、口臭臨床の現場において適切な口臭に関する治療、予防を実施していくうえで、有用なガイドラインとして活用できると考えられた。

したがって、本研究は、今後の歯科医学・歯科医療の発展に寄与するところが大きいと考えられ、博士（歯学）の学位を請求するのに十分価値あるものと認められた。