

THE EFFECTIVENESS OF WHITENING TOOTHPASTES IN REDUCING EXTRINSIC DENTAL STAIN

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Summary

The purpose of the present study was to compare the effectiveness of whitening toothpaste in reducing extrinsic stain with conventional fluoride paste. Total of 33 patients with visible extrinsic dental stains were surveyed. Participants were divided into 3 groups according to different toothpastes used. Lobene Stain Index was measured at baseline, after 2 and 4 weeks. It was determined that whitening toothpastes can remove dental stains. Whitening toothpaste Elgydium® whitening was more effective in reducing dental stains than conventional toothpaste Colgate Total® and whitening toothpaste Colgate Total® Advanced whitening. Longer periods of whitening dentifrice use helps to reach better extrinsic stain removal effect.

INTRODUCTION

Antiseptic rinses are used for treating gingivitis and periodontitis [13]. Rinses containing chlorhexidine are both popular and effective [11], although they might cause extrinsic staining on teeth and tongue [12]. Chlorhexidine is known to produce staining by impacting the tooth surface with dietary chromogens such as those found in tea, coffee and other beverages [9]. Smoking can also be considered as a source of stain. In all cases, extrinsic colour is linked with the adsorption of materials into the acquired pellicle on the surface of enamel, which ultimately causes staining [7] and does not penetrate into dental tissues. Toothpaste requires a certain amount of abrasivity in order to reduce extrinsic stains or prevent their forming, since low or non-abrasive toothpaste is unable to prevent extrinsic stain formation [6]. The abrasive component of toothpaste contributes to the physical removal of stains, plaque and food debris [7]. In order to optimise the removal and control of extrinsic stain, specific abrasives can be added to toothpaste. These improved stain removal/prevention products are termed whitening toothpastes [7]. Higher abrasive level of whitening toothpastes leads to their whitening effect

[4, 6, 10]. However, the abrasivity of toothpaste has to be moderate to prevent removal of the underlying hard dental tissue [6].

The present study investigated the effect of whitening toothpaste in reducing extrinsic stain as compared to conventional fluoride paste. The hypothesis claimed that dental stains can be removed by using a whitening dentifrice.

The aims of the study were: 1) to evaluate the stain removing properties of whitening toothpastes Elgydium® whitening and Colgate Total® Advanced whitening and conventional fluoride paste Colgate Total® as a control; 2) to compare the whitening effect of both commercially available whitening toothpastes.

MATERIALS AND METHODS

Prior to the study, Permit No. 66 was obtained from the Ethics Committee. A group of 33 healthy dentate adult volunteers, who attended to Zalgirio Clinic of Vilnius University Hospital as patients, were recruited for this study. A fully informed written consent was obtained from all participants. Healthy subjects of both genders were involved in the study. The subjects were dentate and had at least 20 natural teeth and no fixed or removable orthodontic appliances or removable prosthesis. No medical or pharmacotherapy history that could have compromised the outcome of the study was determined. Smoking was not a criterion for exclusion. Prior to the study, each subject received a thorough prophylaxis to remove all staining, calculus and plaque and was instructed to rinse with 5 ml 0.12% chlorhexidine mouthwash for 60 seconds twice a day after brushing the teeth with conventional fluoride paste Colgate Total®. After two weeks, the level of visible extrinsic stain was assessed. The subjects were randomly divided into 3 equal groups. The study was single – blind. The subjects in group E (test group) were assigned to Elgydium® Whitening (E), the subjects in group W (test group) were assigned to Colgate Total® Advanced whitening (W) and the subjects in group T (control group) used Colgate Total® (T).

All patients were instructed to brush teeth twice a day with provided dentifrice and identical soft toothbrushes.

Tooth staining was assessed at baseline, then after 2 and 4 weeks. During each visit, extrinsic stain on the buccal surfaces of the upper and lower central and lateral incisors and canines was scored by using Lobene Stain index [3, 8]. The area of stain on buccal surface of each assessable incisor and canine were observationally scored by using the four-point scale: 0 - no stain detected, only tooth colour; 1 - stain covering up to one-third of the tooth surface; 2 - stain covering between one third and two-thirds of the tooth surface; 3- stain covering more than two-thirds of the tooth.

The second criterion of Lobene Stain Index – the intensity of stain - was observationally scored by using the four-point scale: 0 - no stain; 1 - light stain; 2- moderate stain; 3- heavy stain.

Stain product was scored by multiplying the values of stain intensity and area for each tooth.

On completion of the study, the volunteers were seen to remove any deposits of stain, plaque and calculus and asked to fill in questionnaires about smoking and coffee/tea drinking habits and to evaluate the whitening effect of the used dentifrice.

STATISTICAL ANALYSIS

The data were analysed using SPSS 17.0 statistical software. Initially, the whole-mouth mean stain area score, stain intensity and product were calculated for every assessment day. The initial outcome measures were summarized by calculating the mean and standard deviation for each toothpaste group. The main analysis was

performed by using independent samples *t* test to compare the results among the groups and paired samples *t* test to evaluate stain removal within the groups. Point estimates, 95% confidence intervals and P-values were calculated for differences among the groups. The same tests were applied when comparing the questionnaire results with the clinical data. Preliminary examination of the data did not suggest any serious deviation from Gaussian distributional form as such confirmatory non-parametric analyses were not performed to assess the influence of the time period.

RESULTS

All 33 subjects completed the test period. None of the subjects were either suspected or known to have seriously violated the protocol. Initially there was no significant difference in stain levels between the groups ($p > 0,05$).

The analysis of changes from baseline during week 2 showed reduction in stain area and product in all groups, but the difference was not significant. A significant change in stain intensity was noted only for Elgydium® Whitening dentifrice ($p = 0,04$).

When comparing the stain level changes after 4 weeks, it was evident that Elgydium® Whitening group showed the greatest reduction in stain area and it was significant. ($p = 0,005$) (Chart 1). Moreover, this paste exhibited significant reduction of stain intensity ($p = 0,03$) (Chart 2).

Changes in stain intensity and area throughout a four-week period were insignificant for Colgate Total® Advanced whitening and Colgate Total® toothpastes ($p > 0,05$).

The same tendency was recorded when assessing stain product values (Chart 3).

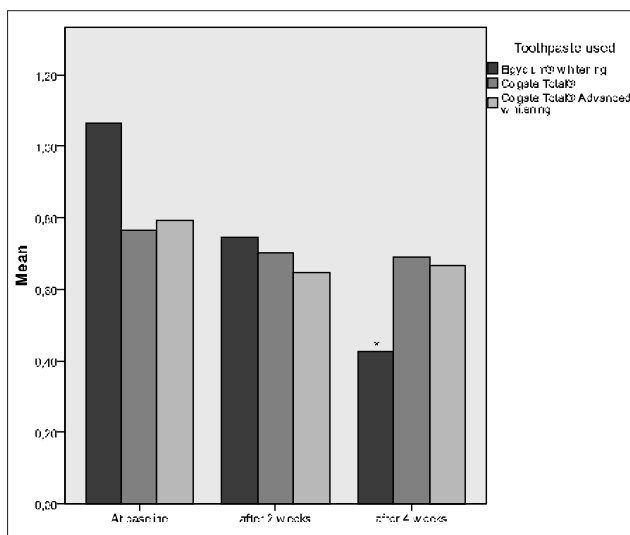


Chart 1. Stain area.

* A significant change in stain area was noted only for Elgydium® Whitening dentifrice after 4 weeks of study ($p < 0,05$).

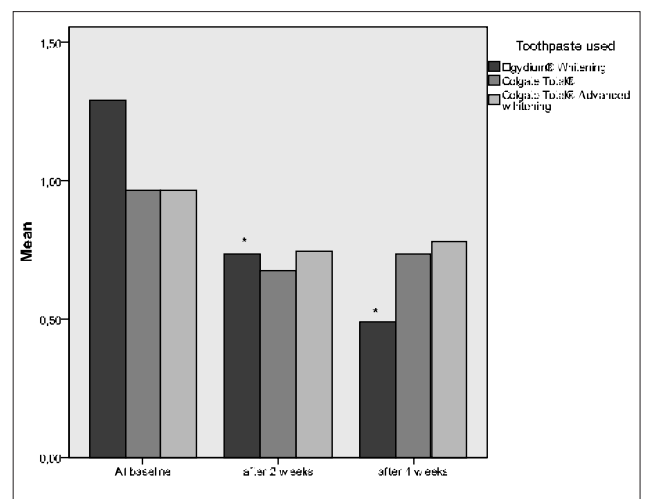


Chart 2. Stain intensity.

* Only Elgydium® Whitening paste exhibited significant reduction of stain intensity after 2 and 4 weeks ($p < 0,05$).

It was noticed that dentifrices were more effective in reducing extrinsic stain when used for a longer period of time. However, Colgate Total® Advanced whitening and Colgate Total® exhibited greater reduction of stain levels following the first two weeks of home usage.

The evaluation of the questionnaire data revealed no significant difference in stain intensity or area between smokers and non-smokers ($p > 0,05$).

There were also no significant differences between subjects consuming tea/coffee every day and ones who do not ($p > 0,05$). It can be concluded that these habits did not influence our results.

The subjects' evaluation of whitening effect of toothpastes was similar to the clinical findings. Elgydium® Whitening was rated to have the best whitening effect, while Colgate Total® Advanced whitening was rated the worst.

DISCUSSION

Due to their abrasive properties whitening toothpastes can be used to reduce extrinsic dental staining [4, 6, 10]. Various studies have proposed different results concerning clinical value of using such toothpastes. J. Moran *et al.* (2005) suggest that whitening toothpaste may have some advantages over conventional paste in removing stain, but the magnitude of difference would appear to be small and of little clinical relevance [9]. Another clinical study also demonstrated a lack of clinical activity of the commercial whitening toothpaste [2]. A study performed by T. F. Walsh *et al.* (2005) concluded that whitening dentifrices had a significant effect in reducing tooth staining over a six-week period [11]. The results from a stain removal clinical study performed by N. Hughes *et al.* (2009) demonstrated significant extrinsic stain removal efficacy for all whitening dentifrices relative to baseline [5]. A. Joiner (2010) in his review suggests that it can be difficult to compare clinical results between studies due to a number of possible factors including different stain indices being used, differences in subject demographics, smoking and eating habits, study protocol differences and *etc.* [7]

This statement can be supported by comparing the protocol of this study with ones from previous studies on extrinsic stain removal. Firstly, different protocols of home-use and toothpaste formulations are used (in N. Claydon *et al.* study the subjects were asked only to rinse with toothpaste slurry, while in the study performed by T. F. Walsh *et al.* patients in one group used not only toothbrushes but also tooth polishers and whitening/stain removing mouthwash). Secondly, the study periods were of varying duration (from 7 days in J. Moran *et al.* study and 4 days in N. Claydon *et al.* study to 6 weeks in T. F.

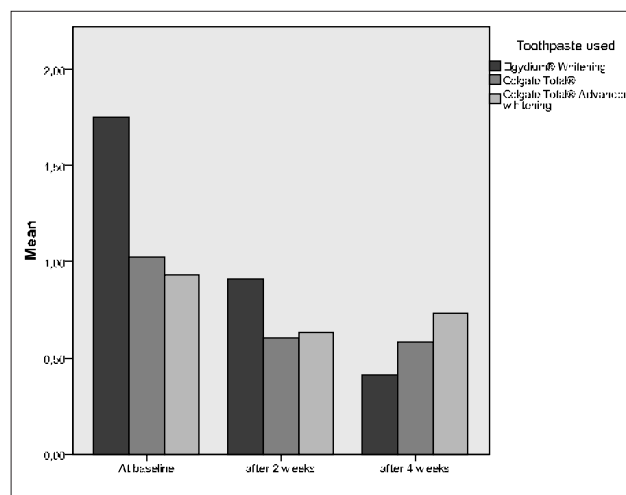


Chart 3. Stain product.

Walsh *et al.* and N. Hughes *et al.* studies) [9, 2, 11, 5]. Thirdly, extrinsic stains were measured at different intervals using different indices (Lobene Stain index was used by J. Moran *et al.*, N. Claydon *et al.*, while N. Hughes *et al.* measured MacPherson's Modification of the Lobene Stain Index (MMLSI) and T. F. Walsh *et al.* used Shaw and Murray stain index) [9, 2, 5, 11].

The toothpastes used in the present study were commercially available whitening toothpastes containing specific abrasives and a conventional toothpaste which also contains abrasives, and some stain removing effect could be expected even by this product. According to the information provided by manufacturers, the whitening element of Elgydium® whitening dentifrice is micro-pulverised sodium bicarbonate, while in Colgate Total® Advanced whitening Dual Silica technology is used. There are a number of key parameters that have been demonstrated to affect the abrasive cleaning process, including particle hardness, shape, size, size distribution, concentration and applied load [7]. Different abrasive particles most probably had an impact on toothpastes' extrinsic stain removal ability in the present study. The reduction in tooth staining in all groups (including the control group) can also be related to oral hygiene, motivation and teeth brushing skills. Oral hygiene was not evaluated at any point during this study. However, it was considered that all patients had equal opportunities to take care of their oral hygiene since they all received uniform toothbrushes and were instructed how to take care of their oral hygiene at baseline and after two weeks. Unfortunately it is impossible to control and achieve alike teeth brushing of the subjects during home-use clinical trial.

Lower amounts of extrinsic stain could also be found

due to an improved tooth brushing. It is likely that a renewed interest in tooth brushing could be caused by the Hawthorne effect which leads to greater efforts of subjects in trial due to the fact that they participate in the study [1].

33 patients had been invited to participate in this study. The sample of subjects was sufficient to obtain statistically reliable results, since it was based on a similar experimental studies experience: J. Moran *et al.* - 24 participants, divided into two groups (test and control), Claydon *et al.* - 24 participants in three groups (two test groups and the control group) [9, 2].

This study was not aimed at determining the most effective commercially available whitening toothpaste. Such a goal could be reached only by examining all commercially available whitening toothpastes. However, the amount of dentifrices used in the present study was sufficient to support the statements that whitening dentifrice may have an advantage over conventional fluoride toothpaste in reducing extrinsic dental stains and that different whitening toothpastes may have different extrinsic stain removal efficacy.

CONCLUSIONS

1. Whitening toothpastes can remove dental stains.
2. Whitening toothpaste Elgydium® whitening was more effective in reducing dental stains than conventional toothpaste Colgate Total®.
3. Whitening toothpaste Elgydium® whitening was more effective in reducing dental stains than whitening toothpaste Colgate Total® Advanced whitening..
4. Longer periods of whitening dentifrice use helps to reach better extrinsic stain removal effect.
5. No significant difference in reducing stains was noted between Colgate Total® Advanced whitening and Colgate Total®.
6. Coffee/tea intake or smoking did not influence the results of present study.
7. The patients' evaluation of whitening toothpaste whitening properties complied with the clinical results.

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BALINANČIŲ DANTŲ PASTŲ ĮTAKA PIGMENTINIŲ DANTŲ APNAŠŲ ŠALINIMUI

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Raktažodžiai: balinanti dantų pasta, pigmentinės dantų apnašos. Santrauka

Tyrimo tikslas buvo palyginti balinančių ir įprastinių dantų pastų efektyvumą šalinant pigmentines dantų apnašas. Tyrime dalyvavo 33 pacientai, kuriems buvo nustatytos pigmentinės dantų apnašos. Tiriamieji buvo padalyti į 3 grupes. Kiekvienai grupei paskirta naudoti skirtingą dantų pastą: balinančios Elgydium® whitening, Colgate Total® Advanced whitening ir įprastinė Colgate Total®. Tyrimo pradžioje, po 2 ir 4 savaičių buvo vertinamos pigmentinės apnašos remiantis Lobene indekso kriterijais. Nustatyta, jog balinančios dantų pastos efektyvios šalinant pigmentines dantų apnašas. Balinančioji pasta Elgydium® whitening buvo efektyvesnė šalinant pigmentines apnašas negu įprastinė Colgate Total® ir balinanti dantų pasta Colgate Total® Advanced whitening. Ilgiau naudojant balinančias pastas pastebėtas didesnis efektyvumas.

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