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RESEARCH ARTICLE

COMPARATIVE ANALYSIS OF WHITENING TOOTHPASTES IN REDUCING EXTRINSIC DENTAL STAIN: A CLINICAL STUDY

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ABSTRACT

Aim: The purpose of the present study was to compare the effectiveness of whitening toothpaste in reducing extrinsic stain with conventional fluoride paste. **Materials and Methods:** 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. **Results:** The results at baseline during week 2 showed reduction in stain area in all groups, but the difference was not significant. When comparing the stain level changes after 4 weeks, it was evident that Elgydium Whitening group showed the greatest reduction in stain area; it was significant. ($p = 0.005$) and stain intensity ($p = 0.03$) Moreover, this paste exhibited significant reduction of stain intensity ($p = 0.03$). 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 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. **Conclusion:** 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.

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INTRODUCTION

Antiseptic rinses are used for treating gingivitis and periodontitis (Pekonienë, 2010). Rinses containing chlorhexidine are both popular and effective (Walsh *et al.,* 2005], although they might cause extrinsic staining on teeth and tongue (Zanatta *et al.,* 2010). Chlrohexidine is known to produce staining by impacting the tooth surface with dietary chromogens such as those found in tea, coffee and other beverages (Moran, 2005). 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 (Joiner, 2010] 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 tooth- paste is unable to prevent extrinsic stain formation (Joiner , 2006). The abrasive component of toothpaste contributes to the physical removal of stains, plaque and food debris (Joiner, 2010].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 (Joiner, 2010). Higher abrasive level of whitening toothpastes leads to their whitening effect (He, 2007; Joiner 2006; Terézhalmy, 2007). However, the abrasivity of toothpaste has to be moderate to prevent removal of the underlying hard dental tissue (Joiner, 2006). 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

- 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;
- To compare the whitening effect of both commercially available whitening toothpastes.

MATERIALS AND METHODS

A group of 33 healthy Adult patients were selected from patents referred to the department of Periodontics Govt Dental College Srinagar 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 through prophylaxis to re- move 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 1 (test group) were assigned to Elgydium Whitening, the subjects in group 2 (test group) were assigned to Colgate Total Advanced whitening and the subjects in group T (control group) used Colgate Total. 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 (Gadhia *et al.,* 2006; Lobene, 1968). 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 in- tensity of stain - was observationally scored by using the four-point scale: 0 - no stain; 1 - light stain; 2- moderate stain; 3- heavy stain. 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.

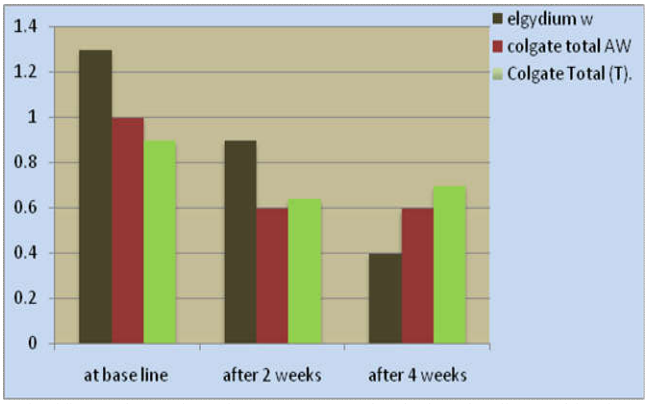
Statistical analysis: The data were analyzed using SPSS 17.0 statistical software. Initially, the whole-mouth mean stain area score, stain intensity and product were calculated for every assessment day. The initial outcome measures were summarized by calculating the mean and standard deviation for each 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. ($p = 0.005$) (Chart1). 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 ($p > 0.05$). 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 tooth- pastes 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.

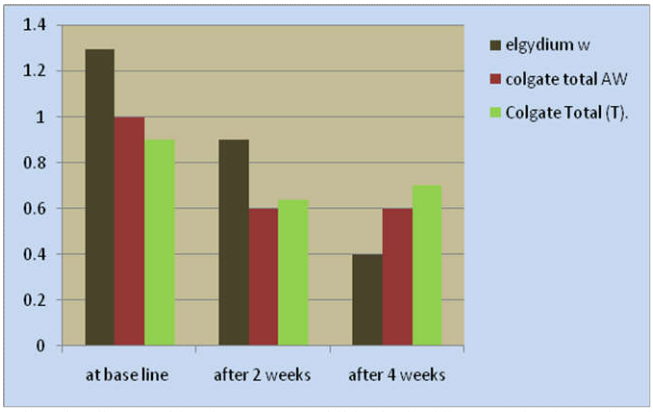
DISCUSSION

Due to their abrasive properties whitening toothpastes can be used to reduce extrinsic dental staining (He, 2007; Joiner, 2006; Terézhalmy, 2007). 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 (Moran, 2005). Another clinical study also demonstrated a lack of clinical activity of the commercial whitening toothpaste (Claydon *et al.,* 2004). 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 (Walsh *et al.,* 2005). 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 (Hughes *et al.,* 2009). 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 (Joiner, 2010). 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 Claydon *et al.* study to 6 weeks in T. F.



* A significant change in stain area was noted only for Elgydium Whitening dentifrice after 4 weeks of study ($p < 0.05$).

Chart 1. Stain area



*Only Elgydium Whitening paste exhibited significant reduction of stain intensity after 2 and 4 weeks ($p < 0.05$).

Chart 2. Stain intensity

Walsh et al. and N. Hughes et al. studies) (Moran, 2005; Claydon *et al.,* 2004; Hughes *et al.,* 2009). 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 Mac Pherson's Modification of the Lobene Stain Index (MMLSI) and T. F. Walsh et al. used Shaw and Murray stain index) (Moran, 2005; Claydon, 2004; Hughes *et al.,* 2009; Walsh *et al.,* 2005). 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 micropulverised 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 (Joiner, 2010). 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 Hawtorne effect which leads to greater efforts of subjects in trial due to the fact that they participate in the study (Adair, 1984). 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) (Gadhia *et al.,* 2006; Claydon, 2004). 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

Conclusion

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

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