EFFICACY OF AN IONIC TOOTHBRUSH ON GINGIVAL CREVICULAR FLUID - A PILOT STUDY

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ABSTRACT

The aim of this study was to compare the efficacy of an ionic and a conventional toothbrush in reducing gingival inflammation measured by gingival crevicular fluid (GCF) volume. Twenty dental students participated in this randomized cross-over clinical trial. Quigley-Hein (QH) Plaque Index was assessed in six sites per tooth. GCF was measured in 3 teeth. Two experimental periods of 28 days with a 14-day washout were set. Mean values of GCF were calculated and tested by paired sample t-test. Correlations between %QH=0 and alterations in GCF were performed. No significant differences were observed between conventional and ionic toothbrushes respectively neither at baseline (.62±.19 vs. .55±.18) nor at 28 days (.44±.12 vs. .47). A negative correlation (-.33) was detected between the increase in % of QH=0 and GCF for both brushes. It may be concluded that the performance of an ionic toothbrush does not differ from that of a conventional brush.

Key words: *ionic toothbrush, cross-over design, gingival crevicular fluid.*

EFICÁCIA DE UMA ESCOVA IÔNICA AVALIADA ATRAVÉS DO FLUÍDO CREVICULAR GENGIVAL

RESUMO

O objetivo desse estudo foi comparar a eficácia das escovas iônica e convencional na redução de inflamação gengival através de medidas do fluído crevicular gengival (FCG). Vinte alunos de odontologia participaram desse ensaio clínico cruzado randomizado. Índice de placa de Quigley-Hein (QH) foi avaliado em seis sítios por dente. FCG foi medido em três dentes. Dois períodos experimentais de 28 dias com um período de wash-out 14 dias foram realizados. Valores médios do FCG foram calculados e testado através do teste t pareado. Correlações entre %QH=0 e alterações no FCG foram realizadas. Diferenças estatisticamente significantes não foram observadas entre os grupos nem no início (.62±.19 vs. .55±.18) nem em 28 dias (.44±.12 vs. .47) para escova convencional e iônica respectivamente. Uma correlação negativa (-.33) foi detectada entre o aumento no % de QH=0 e FCG para ambas escovas. Pode-se concluir que a performance da escova iônica não é diferente da convencional.

Palavras chave: *escova iônica, delineamento cruzado, fluído crevicular gengival.*

INTRODUCTION

The toothbrush is the most widely used plaque control instrument in populations [1]. Its mechanism of action is related to the mechanical attrition that occurs between the bristles and the dental surface, disrupting the biofilm.

In searching to improve the efficacy of toothbrushing, the ionic toothbrush was developed to change the polarity of the tooth surface and thus facilitate plaque removal [2]. Some studies have been performed with ionic toothbrushes [2-4]. However the results are contradictory. Van Swol et al. [2], in a 6 month clinical trial demonstrated a greater reduction in gingival inflammation with the use of an ionic toothbrush. Conversely, Pucher et al. [4] observed a reduction in Gingival Index during 6 weeks with the use of an ionic toothbrush, not different to that observed with a conventional toothbrush.

Different endpoints are used to test the efficacy of toothbrushes. The use of Plaque and Gingival Indexes are the most common forms of evaluation [5]. The amount of gingival crevicular fluid, which is a very sensitive way of assessing gingival inflammation, has not been frequently used. Additionally, when plaque is concerned, the percent of sites with plaque=0 is an interesting way of assessing the

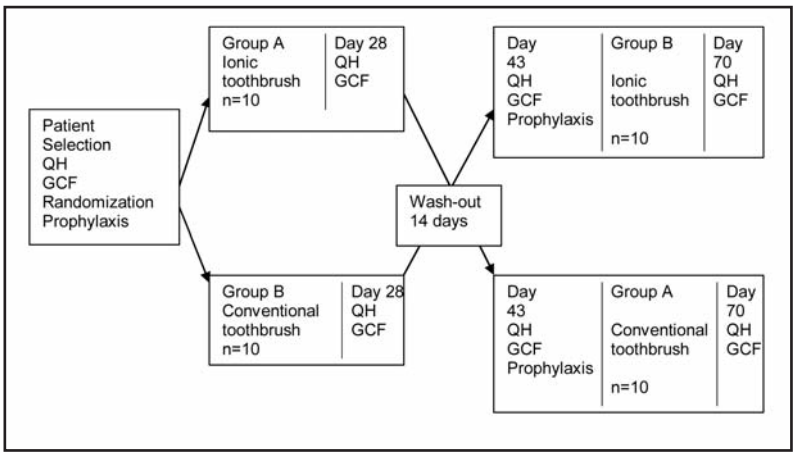

Fig. 1: Experimental design.

potential of a tooth cleaning aid, since the mean values commonly presented might not express the clinical potential in terms of total absence of plaque.

The primary aim of the present study was to compare the efficacy of a conventional and an ionic toothbrush in reducing gingival inflammation measured by Gingival Crevicular Fluid (GCF) volume. Additionally, correlations between GCF alterations and plaque were performed.

MATERIAL AND METHODS

Study panel

The participants of this cross-over randomized controlled efficacy trial were 20 first-year dental students of the Federal University of Rio Grande do Sul, Porto Alegre, Brazil. The age range was 18-29 years (mean = 19.6 yr, 15 females and 5 males).

Inclusion criteria

To be included in the study, volunteers had to present at least 20 teeth with full interdental papillae, be right-handed, have at least 15% of buccal-lingual tooth surfaces with visible plaque and agree to participate in the trial, signing the informed consent. The Ethical Committee of the Federal University Rio Grande do Sul approved this study protocol.

Exclusion criteria

Volunteers with orthodontic appliances, taking any medication that could interfere in plaque formation or that had been under antibiotic treatment during the 3 months prior to the study were excluded.

Experimental toothbrushes

The tested brushes were an ionic toothbrush (HyG ionic, Hukuba Dental Corporation, Japan) and a similar conventional toothbrush (Close up Essential, Unilever, Brazil).

Clinical examinations

Plaque was assessed according to the Turesky modification of the Quigley & Hein Plaque Index (QH) [6] by a blinded calibrated examiner. Full-mouth plaque scores were performed in 6 sites per tooth. Reproducibility of the QH was assessed prior to the study by double scoring of 5 individuals not enrolled in the study, but with similar clinical characteristics. A kappa value of 0.83 was achieved.

GCF was collected in three sites per patient (mesiobuccal of the second upper right premolar, buccal of the upper right central incisor and mesiobuccal of the lower left central incisor 31) during three minutes, according to Löe/Holm-Pedersen (1965) [7] with absorbent paper (Periopaper, Oraflow, New York, USA) and immediately transferred for volume determination in a previously calibrated Periotron (Oraflow, New York USA). Periotron measurement units were transformed to µl.

Study design

At the onset (baseline) and the end (28 days) of each experimental period, QH and GCF were assessed. Individuals were asked to refrain from oral hygiene for 10-12 hours prior to examination. A thorough prophylaxis was performed at the beginning of each period. On the first visit, after examination, individuals were assigned to either one of the toothbrushes (n=10 in each sequence) by flipping a coin. Individuals were then instructed in the use of the corresponding brush twice daily for 2 minutes. No interdental cleaning was performed by the volunteers during the period of 28 days. The same dentifrice was used by all participants during the experiment. A wash-out period of 14 days was given between the experimental periods. Fig. 1 illustrates the experimental design.

Recording of adverse events

If adverse events, according to ADA guidelines [8] occurred, they were photographed. Thus, all oral mucosa and restorations were examined on all visits.

Analysis of the results

The mean gingival fluid was calculated at the two experimental points (baseline and 28 days). Alterations between the two study points within groups and between groups were tested by paired-sample t test.

Mean differences between baseline-28 days in the amount of GCF were calculated and tested between groups with paired-sample t test.

Differences in percentage of plaque zero within each group were calculated and tested by Wilcoxon sign ranks test.

Spearman correlation coefficients between alterations in percentage of plaque zero and GCF at the same sites were calculated. The chosen α-level was 0.05.

TABLE 1. Mean Gingival Crevicular Fluid in μl (±s.d) at baseline and after 28 days of use of the experimental toothbrushes

	Ionic	Conventional	p*
Baseline	0.55±0.18	0.62±0.19	0.40
28 days	0.47±0.11	0.44±0.12	0.37
p*	0.13	0.001	

*Paired t test

TABLE 2. Correlation between percent alterations of dental plaque (QH)=0 and percent alterations of GCF for conventional and ionic toothbrushes

	R	p
%ΔQH=zero-%ΔGCF conventional	-0.33*	0.14
%ΔQH=zero-%ΔGCF ionic	-0.33*	0.16

*Spearman's correlation coefficient

RESULTS

All included subjects completed the study. No adverse events were recorded. The mean gingival crevicular fluid at baseline and after 28 days is shown in Table 1. No differences were detected in GCF at the beginning of each sequence. A statistically significant decrease (paired sample t test, $p<0.05$) in mean GCF was observed only for the conventional toothbrush group (from 0.62±0.19 to 0.44±0.12). In the ionic toothbrush group, no statistically significant difference was observed (0.55±0.18 and 0.47±0.11 at baseline and 28 days, respectively). No inter-group differences were observed in QH in either examination (paired samples t test, $p>0.05$).

When mean differences in gingival crevicular fluid were evaluated among groups, no statistically significant differences were observed (paired sample t test, $p=0.24$). Frequency distribution of plaque zero at baseline and 28 days was 9.27±10.14/17.75±9.60 and 8.42±10.43/16.79±8.93 for ionic and conventional toothbrushes, respectively.

Spearman's correlation coefficient for percent alterations between dental plaque and gingival fluid was –0.16 for the ionic toothbrush and 0.15 for the conventional toothbrush. Spearman's correlation coefficient between percent alteration of dental plaque=0 and percent alteration in GCF was -0.33 for both groups (Table 2).

DISCUSSION

In the present study, alterations in GCF volume were compared between a conventional and an ionic toothbrush. When intra-group values were compared, a significant reduction in GCF volume was observed only for the conventional toothbrush. However, no significant differences were detected when mean differences in GCF volume were considered.

The study group comprised dental students, who, in general, have very low levels of inflammation, conceivably due to better plaque control. However, efficacy studies must be performed in groups of individuals that guarantee compliance and optimize the use of test aids.

Within this context, dental students were chosen for the study. The external validity of studies performed on dental students can be questioned. Therefore, our results should be interpreted with care. Conversely, exploratory studies with other groups of volunteers could not evaluate the real potential of the test brushes[9].

Traditionally, gingival inflammation in toothbrush efficacy studies is measured by Gingival Indexes. In the present study, the quantification of GCF volume was used as a measure of inflammation, since it is a more sensitive way of determining anti-inflammatory effect. It has been demonstrated that reduction in GCF is associated with a site-specific reduction in inflammation[7,10]. To our knowledge, this is the first study that evaluated the potential efficacy of an ionic toothbrush in subclinical gingival inflammation.

Tritten & Armitage[11] compared a sonic and a conventional toothbrush during 12 weeks and did not demonstrate differences in GCF and GI values.

Sampling of GCF was performed according to Löe & Holm-Pedersen (1965)[7], avoiding mechanical stimulation of the crevice in order to minimize bias. The absence of significant differences between the different toothbrushes shown in the present study might be related to the ability of dental students to perform plaque control regardless of the toothbrush. However, it should be noted that gingival inflammation did not increase during the study period, regardless of the absence of interdental plaque control. The GCF measurements were performed in both free and proximal surfaces. A separate analysis of the GCF only on buccal surfaces afforded the same results (data not shown). Pucher et al. [4] did not detect statistically significant differences among an ionic and a conventional toothbrush either, employing gingival inflammation as the end-point.

Additionally to the quantification of GCF volume, alterations in GCF volume were calculated in order to understand the within site inflammatory conditions associated with the use of each test brush. When mean differences in GCF volume were considered, no statistically significant differences were observed between the tested brushes. This result suggests that the potential effect of the ionic toothbrush could not be demonstrated in the study group.

An increase in percent of sites with plaque=0 was observed for both groups, with no statistically significant differences. This could be explained by the Hawthorne effect[12]. Correlations between relative alterations in mean dental plaque and GCF were very weak and not significant.

The correlation coefficient for the association between percentage of QH=0 and alterations in GCF was the same for both toothbrushes (-.33). This negative value indicates that when QH=0 increases, as observed, the mean GCF decreases. This could indicate that plaque and subclinical inflammation decrease concomitantly. However, these data lack statistical significance, conceivably either due to the great variation in values or to the nature of the sample. Within this context, we considered this a pilot study.

Taking into consideration the methods used for this pilot study and its limitations, it may be concluded that the potential performance of an ionic toothbrush does not differ from that of a conventional one in terms of amount of GCF in dental students. Correlations between QH=0 and GCF were negative. Future studies in different study groups are warranted.

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