Single-use plaque removal efficacy of new vs. worn power toothbrush heads

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OBJECTIVES
To compare the efficacy with respect to plaque removal of a new power toothbrush head with a brush head worn by 3 months home-use.

DESIGN
Randomized, cross-over, single-use, single-blind to the examiner.

MATERIALS AND METHODS
This investigation into the effect of toothbrush wear on plaque removal efficacy involved subjects who had taken part in a 3 month comparative study and the brush heads that they had used. All subjects who took part in the study gave written informed consent, and the study was approved by an independent Institutional Review Board.

Subjects were between the ages of 18 to 70 years, in good general health, were non-smokers and had at least 18 scorable teeth (not including third molars, teeth with orthodontic appliances, bridges, crowns or implants). Reasons for exclusion included evidence of neglected dental health, serious medical conditions or use of certain medications (e.g. antibiotics or anti-inflammatory medication within 1 month prior to the start of the study), pregnancy and any physical limitation that would compromise the subject’s ability to carry out normal oral hygiene procedures.

Subjects abstained from all oral hygiene procedures for 23-25 hours prior to the first visit, when they received oral assessments of all soft and hard tissues. All tooth surfaces were then stained for the presence of plaque using a disclosing agent. Subjects having a whole mouth mean pre-brushing plaque score of ≥1.5 as measured by the Modified Quigley-Hein Plaque Index continued in the study. Subjects were then randomly assigned to one of two treatment sequences, new/worn or worn/new. The degree of wear of the worn toothbrushes was evaluated on a 5 point scale from 0 (no wear) to 4 (extreme wear) in order that at the end of the study the amount of plaque removal achieved by each subject could be correlated with the degree of wear of the brush head that they had used. The toothbrush was a Braun Oral-B Battery Toothbrush (D4) which was used with either a new brush head or one that had been worn by the subjects during the previous 3 months of home use. Subjects brushed for two minutes with their assigned brush head and toothpaste (Colgate® Regular, Colgate-Palmolive Co., New York, NY). Following the timed brushing, plaque was reassessed, and subjects were instructed to return to their usual method of oral hygiene for a one-week wash-out period. Subjects returned, after again abstaining from oral hygiene for 23-25 hours, at which time they brushed with the alternate brush head in the sequence (either new or worn) as previously described.
A total of 46 subjects completed the single-use, cross-over phase of the study. The two treatment sequences, new/worn and worn/new, did not differ significantly with respect to pre-brushing whole mouth plaque score, or with respect to gender, race and age.

Brushing for two minutes with either a new or a worn D4 brush head significantly reduced plaque scores ($p<0.0001$). A comparison of the efficacy of the new and worn toothbrushes revealed that for all brush heads combined, irrespective of the degree of wear, there was a tendency for the new brush head to remove more plaque than the worn brush head. For the whole mouth, the new brush reduced the plaque score by 0.61 (±0.04) compared with 0.58 (±0.04) for the worn brush head. However, for all surfaces examined, the difference between new and worn failed to achieve statistical significance. In contrast, when plaque removal was assessed for subjects using brush heads with the most extreme wear i.e. scores of 3 or 4 ($n=15$), a significant difference ($p<0.05$) between new and worn was observed for the whole mouth, approximal sites and facial surfaces (see figures 1 and 2).

**Clinical Comment**

The American Dental Association (ADA) recommends that toothbrushes are replaced regularly, as “worn brushes are not effective at removing plaque bacteria and broken bristles may injure gums”. Dental professionals and toothbrush manufacturers generally recommend that a toothbrush is replaced every 3 months, but most patients fail to comply with this advice this advice, and on average change their brush as little as twice each year. In order to maximize plaque removal when brushing it may be important to ensure that toothbrush wear is kept to a minimum and that brushes are replaced regularly. To date, the number of studies investigating the effect of toothbrush wear has been relatively few and it is still not clear how much effect wear has on efficacy. The results from the study described above suggest that more severely worn brushes are less effective, and supports the recommendations of the ADA. As has been shown elsewhere, brush head wear is particularly relevant with respect to removing plaque from hard to reach areas such as approximal sites. It would appear that worn splayed bristles are less able to gain access to these important areas.