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Manual orthodontic vs. oscillating-rotating electric toothbrush in orthodontic patients: a randomised clinical trial

ABSTRACT

Aim To compare the efficacy of manual and oscillating-rotating electric toothbrushes in removing plaque and reducing gingivitis in patients with fixed orthodontic appliances.

Study design Randomised clinical trial.

Methods 20 subjects aged 10 to 14 years (8 males; 12 females) scheduled for fixed orthodontic treatment were enrolled, randomly divided into two groups, A and B, and later assigned electric or manual toothbrushes, respectively. Three months after orthodontic appliance bonding (T1), and again after a further 4 (T2) and 8 (T3) weeks, plaque levels (PI), gingival bleeding (GBI) and hypertrophy were assessed.

Results Between the two toothbrush types, statistically significant differences in PI were detected from T2 to T3 (P value=0.010), but not from T1 to T2. In contrast, the GBI was significantly different from T1 to T2 (P value=0.025), but not from T2 to T3.

Conclusion With respect to the manual orthodontic toothbrush, the electric oscillating-rotating toothbrush was found to better improve both PI and GBI.

Keywords: Manual toothbrush; Oscillating-rotating electric toothbrush; Orthodontic brackets hygiene

Introduction

Conclusions regarding the plaque removal efficacy of electric toothbrushes vary widely. However, according to the Cochrane report, a review of 29 studies published between 1964 and 2001, with a total of 2547 participants [Penick, 2004], and its 2005 amendment [Robinson et al., 2005], oscillating-rotating toothbrushes are the only powered toothbrushes that remove more plaque than their manual counterparts.

Likewise, Forrest [Forrest and Miller, 2004] found that only the oscillating-rotating toothbrush produced consistently higher and statistically significant reductions

in plaque (7%) and gingivitis (17%), as compared to manual toothbrushes.

Deery et al. [2004] reported that using an electric toothbrush was as least as effective at reducing plaque and gingivitis as manual brushing, but only oscillating-rotating toothbrushes significantly reduced these parameters in the short and long term.

Furthermore, Hamerlynk et al. [2005] found that using an electric toothbrush with rotating-oscillating action for three months reduced the level of gingivitis and plaque, although statistical significance was not demonstrated for the latter. Interestingly, this study also revealed that electric toothbrushes without a rotating-oscillating movement were consistently inferior to manual toothbrushes.

Orthodontic patients bearing fixed appliances are particularly susceptible to gingivitis and decalcification of tooth enamel due to the persistence of plaque. Therefore it is especially important to know which toothbrushes and additional cleaning tools to recommend to these patients as part of their preventative hygiene routine.

Hence, in 2002, Borutta et al. performed a comparative study of manual and powered toothbrushes in orthodontic patients, revealing that the latter were significantly superior as regards plaque removal ($p = 0.0001$) and reduction of gingival inflammation ($p < 0.05$).

However, two recent meta-analyses [Chia, 2008; Kaklamanos and Kalfas, 2008] have concluded that, primarily due to lack of methodological standardisation, no conclusions regarding the superiority of powered toothbrushes in reducing gingivitis in orthodontic patients can be drawn from the evidence currently available.

The aim of this randomised clinical trial was to compare the efficacy of the oscillating-rotating electric toothbrush and an orthodontic manual toothbrush in plaque removal and reduction of gingivitis in patients bearing fixed orthodontic appliances.

Materials and methods

Twenty patients with permanent dentition, aged less than 16 years and scheduled to receive multi-bracket fixed orthodontic appliances were enrolled in this randomised clinical trial in the Orthodontics Department at Genoa University School of Dentistry. The Biostatistics Department of the same university was then asked to divide the patient sample, composed of 8 males and 12 females between 10 and 14 years of age (mean 11.4), into two randomly assigned groups. Patients in Group A, 6 males and 4 females, were provided with an Oral B Professional Care 8500 electric toothbrush, and patients in Group B, 2 males and 8 females, with an Oral B 35 manual orthodontic toothbrush.

The electric toothbrush considered features were the following.

- 3D brushing action with up to 40,000 pulsations/min and 8,800 oscillations/min.
- One-touch speed control permitting the patient to modulate the oscillation/pulsation speed at will.
- A professional timer which emits a sound every 30 sec.
- Oral B Ortho Refill orthodontic brush head, specially designed to clean around orthodontic appliances.

MANUAL ORTHODONTIC VS. OSCILLATING-ROTATING ELECTRIC TOOTHBRUSH IN ORTHODONTIC PATIENTS

The manual toothbrush considered features were the following.

- Angled bristles for effective cleaning of areas around orthodontic brackets
- Small head for better access
- Four rows of bristles, the 2 outer rows being composed of 800 bristles of 1.2 cm length and 0.2 mm diameter, and the 2 inner rows being composed of 800 bristles of 0.8 cm length and 0.3 mm diameter.

Three months after orthodontic appliance bonding (T1) the patients were photographed and examined by two separate operators, who assessed clinical plaque indices (PI) [O'Leary et al., 1973], gingival bleeding scores (GBI) [Ainamo and Bay, 1975], and hypertrophy (classified as absent or present).

At this time, patients were consigned their toothbrushes and instructed as to the norms of oral hygiene and the respective brushing techniques to employ [Bass, 1954]. Each patient was taught how to reach all areas of the mouth with their toothbrush by brushing each tooth for several seconds and instructed by a dental hygienist to clean their teeth in this manner twice a day for a minimum of two minutes.

Group A patients were shown how to guide their electric toothbrush so as to clean one tooth at a time, following the gingival margin and the shape of each tooth and positioning the brush head around the brackets without applying pressure or moving it from side to side.

Group B patients were instructed to use their manual orthodontic toothbrush [Saver and Yankell, 1997; Checchi et al., 2001] with the rotation/vibration technique [McCracken et al., 2004], one dental arch at a time with the mouth open, positioning the brush with the longer, angled bristles around the brackets to clean the tooth and gums while the shorter bristles clean the brackets.

Oral B "Teeth and Gums" toothpaste with stabilised stannous fluoride (0.4%) was used in all cases, and no professional oral prophylaxis was performed on any patient.

The examination performed at T1 was repeated after 4 weeks (T2) and again after 8 weeks (T3).

Statistical analysis

Inferential statistical analysis was performed by the Department of Health Sciences, Section of Biostatistics, Genoa University, Italy, using the SPSS Advanced Models 17.0 statistical analysis software for Windows and Macintosh. Statistical difference was tested at $P < 0.05$. The Mann-Whitney non-parametric test and the Wilcoxon signed ranks test were employed. The intra-class correlation coefficient (ICC) was found to be 0.82. Patient dropout was nil.

Results

Results are shown in Tables 1 and 2. The Mann-Whitney U test revealed statistically significant differences in PI between the two types of toothbrush from T2 to T3 (P value=0.010), but not from T1 to T2. Conversely, a statistically significant difference between the two brush types was seen in terms of GBI from T1 to T2 (P value=0.025), but not from T2 to T3 (Fig. 1, 2).

	GROUP B			GROUP A		
	T1	T2	T3	T1	T2	T3
MEAN	93.20	35.80	24.10	90.00	38.90	17.00
SD	10.97	6.09	4.77	15.71	8.82	2.36

TABLE 1 - Means and standard deviations of PI values of both Groups at the 3 time intervals (T1, T2 and T3).

	GROUP B			GROUP A		
	T1	T2	T3	T1	T2	T3
MEAN	12.10	5.30	1.30	18.1	5.2	0.7
SD	6.40	1.64	1.25	7.69	2.04	1.25

TABLE 2 - Means and standard deviations of GBI values of both Groups at the 3 time intervals (T1, T2 and T3).

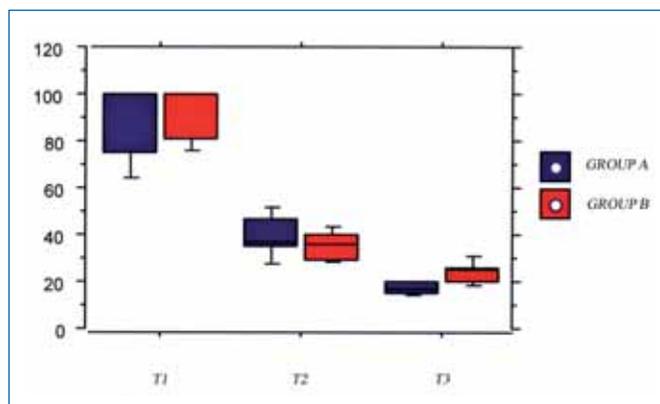


FIG. 1 - Box & whisker plot of PI distribution at T1, T2 and T3 for Group A and Group B.

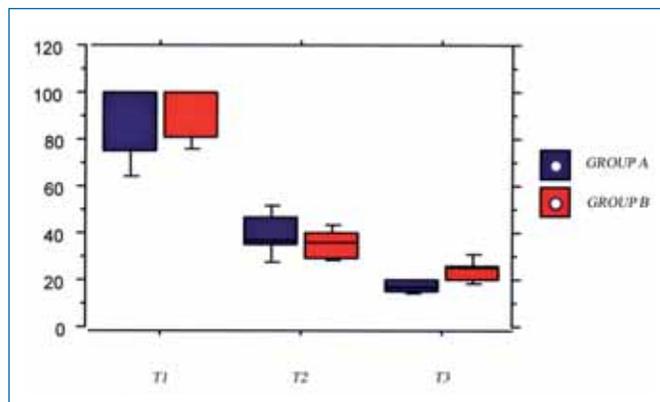


FIG. 2 - Box & whisker plot of GBI distribution at T1, T2 and T3 for Group A and Group B.

Discussion

This prospective study permitted randomised confrontation of the efficacy of two different tooth brushing systems. Variability due to age was found to be not significant in either clinical or statistical terms.

At T1, hypertrophy was evident in all patients. After 4 weeks (T2) hypertrophy was still noticeable in 6 out of 10 patients in Group A (electric toothbrush), and in 7 out of 10 in Group B (manual). After eight weeks (T3), only 2 out

of the 10 Group A patients and 3 out of the 10 Group B patients still showed signs of hypertrophy. Mean plaque index (PI) values for the electric toothbrush were 90.00 at T1, 38.90 at T2 and 20.55 at T3. A similar variation over time in PI was also seen with the manual toothbrush: from 93.20 at T1, to 35.80 at T2, falling to 24.10 at T3. Mean variation in gum bleeding index (GBI) for the electric toothbrush was 18.10 at T1, 5.20 at T2 and 0.7 at T3. Mean GBI for the manual toothbrush started at 12.1 at T1, and was reduced to 5.3 at T2, down to 1.3 at T3.

These results permit us to state that the bleeding gum index was more rapidly lowered than the plaque index. Furthermore, comparing the three time intervals, Wilcoxon's test revealed statistically significant differences between them for both types of toothbrush.

Literature extolling the superior efficiency of electric toothbrushes in reducing gingivitis and improving clinical parameters with respect to their manual counterparts abounds [Haffajee et al., 2001; Davies, 2006; Heanue et al., 2003].

In accordance with the systematic review of available data performed by Robinson [Robinson et al., 2005] we found a greater efficacy of the oscillating-rotating electric toothbrush in significantly reducing plaque and gum disease in orthodontic patients, as compared with a manual toothbrush. Our results also confirmed the findings reported by Hamerlink et al. [2005] regarding reduction of gingivitis, although in our study this was evident at 4 weeks rather than 12.

Furthermore, a statistically significant reduction in plaque levels was seen in our study after 8 weeks, confirming the results of a comparative study performed by Pizzo et al. [2009], in which an oscillating-rotating electric toothbrush was compared with two types of manual toothbrush in a group of 66 patients. In this case, plaque levels were evaluated using the Turesky-modified Quigley-Hein Plaque Index, revealing that the electric toothbrush was more effective in reducing plaque on the proximal surface of all teeth with respect to the two manual versions. In this clinical research, we noted that the reduction in plaque levels and bleeding gum index is strictly related to the dental hygienist continual work of instruction about the correct use of toothbrushes, subsequent motivation and monitoring of oral hygiene of orthodontic patients. In one subject two small abrasions were noted on the gums after one month of using the electric toothbrush.

Conclusions

This trial has revealed significantly different results between the two types of toothbrush as regards the clinical indices considered. In our sample, Group A patients, who used the Oral B Professional Care electric toothbrush, were found to have a greater positive variation in plaque and bleeding gum indices with respect to those in Group B, who were provided with a manual toothbrush.

Furthermore, it should also be stated that proper instruction regarding brushing technique and continual monitoring and motivation by the dental hygienist contributed greatly to the global improvement in oral hygiene in all patients examined.

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