SHORT COMMUNICATION

Comparative study of 3 types of toothbrushes in patients with fixed orthodontic appliances

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Introduction: Plaque and trapped debris that accumulate gingivally to orthodontic wire are difficult to remove. The triple-headed toothbrush (TH-TB) was designed to reach the gingival tooth margin. In this study, we examined its effectiveness in improving the oral health of orthodontic patients as compared with conventional and orthodontic toothbrushes. **Methods:** Orthodontic patients (n = 94; mean age, 15.6 ± 3.9 years) receiving edgewise treatment in both arches were randomly assigned to 1 of 3 groups (TH-TB, orthodontic toothbrush, and conventional toothbrush). After toothbrushing instruction, each participant received professional tooth cleaning. Tooth plaque index, bracket plaque index, gingival index, and bleeding index were recorded at baseline and after 4 weeks of usage. Satisfaction level was obtained after 4 weeks. **Results:** The TH-TB was significantly more effective than conventional and orthodontic toothbrushes in tooth-plaque removal by 2-fold and 1.5-fold, respectively ($P < .001$); in bracket-plaque removal by 3-fold and 2-fold, respectively ($P < .001$); and in improving gingival health by 6-fold and 1.5-fold, respectively ($P = .011$). Patients who used the TH-TB were significantly more satisfied than those who used the other toothbrushes ($P < .001$). **Conclusions:** The TH-TB is a practical alternative to other manual toothbrushes to improve tooth and gingival health in orthodontic patients wearing fixed appliances. (Am J Orthod Dentofacial Orthop 2006; 130:92-5)

Patients undergoing orthodontic treatment with fixed appliances have a challenging oral hygiene situation because brackets tenaciously trap food and other oral debris. Several toothbrushes have been designed to increase plaque removal efficacy in orthodontic patients. Most orthodontic toothbrushes (O-TB) have a V-shaped groove along the long axis of the toothbrush head. The shorter nylon bristles in the V-shaped groove are progressively firmer and more efficient in removing food debris from the midbracket region, and longer, softer filaments are positioned in the bracket-wing region. Tests of the effectiveness of the O-TB compared with the conventional toothbrush (C-TB) in reducing plaque and gingivitis in teeth with fixed appliances have had conflicting results.[1,2]

Recently, a manual triple-headed toothbrush (TH-TB) (Dr Barman Superbrush, Dentaco AS, Haukeland, Norway) (Fig 1) was designed to clean the lingual, buccal, and occlusal tooth surfaces simultaneously. Its head contains short, firm bristles in the center to clean the occlusal surfaces and longer, softer bristles outside that reach the dentogingival margin at a 45° angle to gently clean the smooth tooth surfaces there. Several studies have shown that the TH-TB is superior to the C-TB in reducing plaque accumulation at the gingival margin and in improving the modified gingival index (GI) and the bleeding on probing (BOP) index in children and adults.[3,4] Because plaque accumulation in orthodontic patients is mainly gingival to the brackets along the gingival margin, we evaluated the effectiveness of plaque removal and gingival health improvement in children undergoing orthodontic treatment with manual C-TB, O-TB, and TH-TB, and the patients' preferences for these toothbrushes.

MATERIAL AND METHODS

The study comprised 94 healthy patients (mean age, 15.6 ± 3.9 years) without periodontal disease (according to the bite-wings), who came for orthodontic treatment at the Department of Orthodontics, School of Dental Medicine, Tel Aviv University. There were 37 (39.4%) males and 57 (60.6%) females. The patients were randomly placed in 1 of 3 groups according to type of toothbrush: 32 TH-TB, 31 O-TB (#124, Butler G.U.M., Chicago, Ill), and 31 C-TB (M-27, Paro, Esro AG, Kilchberg, Switzerland) (Fig 1). A structured form

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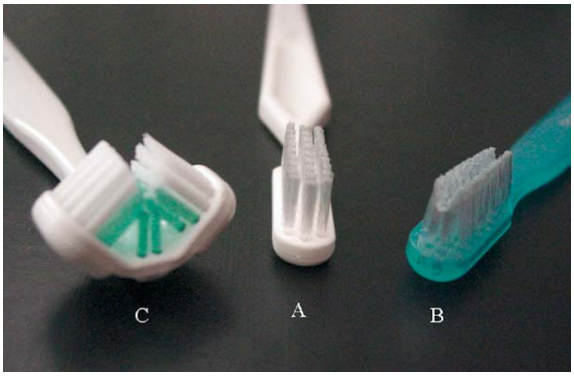


Fig 1. Toothbrushes evaluated: **A,** conventional; **B,** orthodontic; **C,** triple-headed.

was designed to collect demographic and dental variables, including the patient's age, sex, type of toothbrush, baseline and final plaque (tooth and bracket) indexes, GI, BOP index, and satisfaction. The Ethics Committee of Tel Aviv University approved the study. Written consent was obtained from each patient before the study, or parental consent was obtained for patients under 18 years old.

The patients were instructed to brush their teeth twice a day and follow the recommended manufacturer's technique for each toothbrush used: O-TB, horizontal scrub technique; C-TB, modified Bass technique; and TH-TB, horizontal scrub while tilting the brush head outwards and inwards. To improve plaque removal around orthodontic brackets, the patients were instructed to brush 15 strokes in each group of tooth surfaces. All patients used the same toothpaste (Aquafresh Mild Mint, GlaxoSmithKline, Brentford, United Kingdom), provided free of charge.

Each participant received professional tooth cleaning to obtain a plaque-free condition at baseline. Four indexes were measured, scored, and recorded at baseline and after 4 weeks, as previously described[5]: plaque index-bracket (PIB), plaque index-tooth (PIT), GI, and BOP index.

Teeth without brackets and banded molars were excluded from the study. Since the lingual tooth aspects were irrelevant to evaluate the efficacy of the toothbrushes in orthodontic patients, they were not examined.

At the end of the study, each participant rated his or her satisfaction with the toothbrush used according to the perception of its efficiency in plaque removal and ease of handling: very unsatisfied (score 1), unsatisfied (score 2), satisfied (score 3), and very satisfied (score 4). One dentist (Z.R.), who was blinded to the type of toothbrush used, performed all examinations. At the start of the study, the first 10 patients were recorded twice in a 2-hour interval to validate the scales to be used and to calibrate the 4 indexes.

The Pearson chi-square test was used to evaluate the significance of differences among proportions and 1-way analysis of variance (ANOVA) and the Tukey method were used to evaluate continuous variables.

RESULTS

All participants had statistically comparable baseline conditions for oral hygiene and gingival health (Table). The GI values of all participants were significantly lower on the left side than on the right in both arches ($P = .003$ and $P < .001$, respectively). Similarly, the PIB values on the left side were lower than on the right in the mandibular arch ($P = .032$).

After 4 weeks, the TH-TB was significantly more effective than the C-TB and the O-TB in tooth-plaque removal, by 2-fold and 1.5-fold, respectively ($P < .001$) (in the maxillary arch, by 2.9-fold and 1.6-fold, respectively [$P = .003$] and in the mandibular arch by 1.8-fold and 1.6-fold, respectively [$P < .001$]), and in bracket-plaque removal by 3-fold and 2-fold, respectively ($P < .001$) (in the maxillary arch by 3.4-fold and 2.0-fold, respectively [$P < .001$], and in the mandibular arch by 2.3-fold and 1.6-fold, respectively [$P = .002$], Fig 2). However, no significant differences were found between patients who used the C-TB or the O-TB. At the end of the study, no statistical differences were found between arches in the PIT and the PIB in any group.

After 4 weeks, the TH-TB was significantly more effective than the C-TB and the O-TB in improving gingival health, by 6-fold and 1.5-fold, respectively ($P = .011$). These differences were also valid in both arches separately: in the maxillary arch by 2.5-fold and 1.3-fold respectively ($P = .017$) and in the mandibular arch by 3.6-fold and 1.6-fold, respectively ($P = .018$).

The GI was statistically higher in the mandibular arch after 4 weeks ($P = .04$) only in patients using the C-TB. No such differences were found in the other groups. In contrast to the baseline, the GI at the end of the study was comparable on both sides.

The bleeding on probing index did not change significantly after 4 weeks of brushing with any of the toothbrushes.

Nearly all patients—92 of 94 (97.8%)—used a C-TB before the study. At the end of the study, 34.3% and 53.2% of the patients who used the TH-TB were satisfied or very satisfied with it, respectively, compared with only 25.8% and 22.5%, of the patients who used the O-TB, and 22.6% and 9.6% of the patients who used the C-TB, respectively ($P < .001$; Tukey: C-TB and O-TB $\neq$ TH-TB).

Table. Plaque index-tooth (PIT), plaque index-bracket (PIB), modified gingival index (GI), and bleeding on probing (BOP) index at baseline and after 4 weeks with each toothbrush

	PIT total (SD)		*PIB total (SD)*		*GI total (SD)*		*BOP total (SD)*	
Type of toothbrush	*Before*	*After*	*Before*	*After*	*Before*	*After*	*Before*	*After*
C-TB (a)	1.64 (0.64)	1.22 (0.50)	1.91 (0.57)	1.56 (0.55)	2.65 (0.59)	2.43 (0.59)	0.57 (0.61)	0.37 (0.37)
O-TB (b)	1.79 (0.57)	1.22 (0.47)	2.00 (0.49)	1.52 (0.51)	2.86 (0.58)	2.33 (0.58)	0.60 (0.39)	0.40 (0.26)
TH-TB (c)	1.70 (0.54)	0.82 (0.41)	2.03 (0.47)	1.10 (0.42)	2.76 (0.66)	2.01 (0.52)	0.63 (0.43)	0.23 (0.29)
Significance (*P* value)	.57	.001	.57	<.001	.4	.011	.86	.07
Tukey	a = b = c	c ≠ a, b	a = b = c	c ≠ a, b	a = b = c	c ≠ a, b	a = b = c	a = b = c

DISCUSSION

Our results indicate that the TH-TB is statistically superior to the C-TB and the O-TB as expressed by a significantly lower score in 3 of the 4 indexes (PIT, PIB, and GI).

The reason for these results can be attributed to the unique inclination of the bristles to reach the gingival margins of the brackets where the plaque is trapped, without the need of special manual skills. Furthermore, the TH-TB is easier to handle. Most patients brush their teeth, on average, less than 90 seconds, so a more effective toothbrush in important.[6]

In this study, the O-TB had comparable effectiveness in improving the PIT, the PIB, and the GI as the C-TB; this agrees with other studies.[2,5]

The BOP index was the only parameter that did not significantly improve during the study. This was probably related to its short-term design; ie, in 4 weeks inflammation could improve at the marginal gingiva but not deeper than that. These results agree with those of Heintze et al,[7] who found statistically significant differences in plaque removal but not in the BOP index.

Gingival health, as expressed by the GI, in the maxillary arch was statistically better than in the mandibular arch only with the C-TB. This could be because the O-TB and the TH-TB are placed more occlusally on the tooth than the C-TB and are less influenced by a shallow vestibular sulcus and a high mentalis muscle attachment, which are present in the mandibular arch. This contradicts other studies.[5,8] Further studies are needed to clarify these differences.

Differences in the left side compared with the right at baseline could be partially explained because right-handed people brush better on the left sides[5] or they spend more time brushing the contralateral side (the left side in a right-handed person).[8] In all groups, improvement in the 4 indexes between the right and left sides after the study emphasized the importance of the dental clinician's instructions and the patient's motivation. The PIB in the mandibular arch ($P = .029$) was the only difference found between the right and left sides, but this was not related to the type of toothbrush. It might show that the mandibular right side is more difficult to brush.

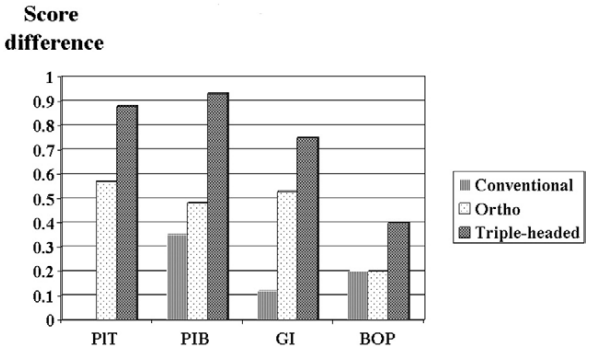


Fig 2. Score improvement in 4 indexes after 4 weeks with each toothbrush used (PIT, plaque index-tooth; PIB, plaque index-bracket; GI, modified gingival index; BOP, bleeding on probing index). Data presented as difference in scores before and after toothbrush used.

The relatively low satisfaction with the C-TB could be because most patients originally used this type of toothbrush and did not notice an innovation with it.

CONCLUSIONS

We found that the TH-TB was significantly more effective in plaque removal and in improving the gingival health of patients with orthodontic fixed appliances. It could be a better alternative to the C-TB or the O-TB.

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