Comparison of efficacy of conventional toothbrush and single tuft brush for the control of dental plaque

Himanshu Aeran[1*], Amrinder Singh Tuli[2], Jyoti Bartwal[3], Lakshya Vishnoi[4], Vibhuti Aeran[5]

[1]Director Principal, Professor and Head, [2]Professor and Head, [3]Post Graduate Student, [4,5]Intern, Dept. of Prosthodontics, [1-3]Seema Dental College & Hospital, Rishikesh, Uttarakhand, [4]KGMC, Lucknow, Uttar Pradesh, [5]Maulana Azad Institute of Dental Sciences, New Delhi, India

*Corresponding Author: Himanshu Aeran
Email: drhimanu4@gmail.com

Abstract
Aim: To compare the effectiveness of a Single Tuft Toothbrush (STB) with Conventional Toothbrush (CT) for the control of dental plaque.
Materials and Methods: Chronic generalized gingivitis patients (n=25) were selected and received professional oral prophylaxis. All the subjects were reevaluated after 7 days and based on the periodontal evaluation (probing pocket depth and clinical attachment level), only periodontally healthy subjects (n=20) were included in the study. Subjects were randomly divided into 2 groups: STB group (n=20); CT group (n=20). Subjects were instructed to use only the assigned toothbrush for 72 hours with a 3-day washout period. The evaluated parameters were Gingival index (Loe and Silness,1963), disclosed plaque index and modified sulcular bleeding index (Momblli,1987) at baseline (T=0) and at the end of each experimental period (T=72).
Results: On intragroup comparison there was statistically significant difference in all the parameters in both groups at 72 hours (p<0.05). On intergroup comparison, statistically significant decrease in all the parameters were seen in ST group (p=0.00).
Conclusion: Single tuft brushes are more effective for control of dental plaque as compared to conventional toothbrush.

Keywords: Periodontally, Conventional toothbrush.

Introduction
Dental plaque is the main etiologic agent in the development of dental caries and periodontal disease. Studies have stated that gingivitis may develop within two weeks without oral hygiene, and that early caries may be detected if the plaque is allowed to accumulate for more than 4 weeks.[1] Progression of gingivitis to periodontitis is accelerated by the imbalance in the bacterial community of the biofilm and the host, leading to the break in the homeostasis.[2] When this homeostasis is broken, visible changes such as spontaneous gingival bleeding, erythema, swelling and changes in gingival texture begin to emerge.[3] Setting up effective measures for the prevention of periodontitis require oral hygiene practices and consequently halting the dental biofilm formation.[4]

Mechanical plaque removal with toothbrushes remains the primary method of removing the plaque and debris from the tooth surfaces. In normal conditions, teeth cleaning solely with conventional toothbrush does not remove the biofilm effectively from all the surfaces.[5] Therefore, auxiliary devices, such as dental tapes, interproximal brushes and/or single tuft brushes are recommended for the thorough removal of the plaque for the specific areas. Generally, the interproximal surfaces and the lingual surfaces of mandible seem to have the most plaque formation. In subjects performing normal oral hygiene measures, buccal surface of the maxillary second molars showed significantly more plaque accumulation compared to that of the first molars, possibly due to the difficulty of cleansing accessibility.[6]

The use of single-tuft brushes (STB) is recommended for hard to reach areas such as buccal or lingual surfaces, crowded teeth, distal surfaces of molars, furcations and proximal surfaces of the isolated teeth. Also, because of the uncomplicated direction of the STB towards the gingival margin, they may be advantageous for the removal of biofilm from deep pockets.[6] The aim of the present study was to compare the effectiveness of the single-tuft toothbrushes against the gold standard, conventional toothbrushes, at controlling the formation of dental biofilm in healthy individuals.

Materials and Methods
Sample selection
Sample size was based on previously published studies of similar design[7,8] and consisted of 25 dental students. The inclusion criteria were: systemically and periodontally healthy subjects (probing depth ≤ 3 mm and no gingival bleeding),[9,10] aged between 18 and 30 years with a minimum of 20 remaining teeth, who agreed to participate in the study. Exclusion criteria were: presence of cervical restorations, antimicrobial therapy for any medical or dental condition within 6 months prior to the trial, use of drugs known to affect the periodontal environment (anti-inflammatories, pain-killers, contraceptives, anticonvulsants, immunosuppressants, cyclosporine, anticoagulants and calcium channel blockers) also within 6 months prior to the baseline periodontal examination, orthodontic treatment or device.

Study design
Two types of toothbrushes were compared: a single-tuft brush (TePe single tufted toothbrush) and a conventional toothbrush. The groups were defined as: STB- single tuft brushes, n=20; CT- conventional toothbrush (gold standard), n=20. During each experimental phase, the subjects were

instructed to use solely the toothbrush designated to their group, excluding any other additional cleaning strategy. Each experimental phase lasted 72 hours with a 3-day washout period in between, in order to avoid a possible residual effect of the previous toothbrush method.

Clinical experimental phase
25 chronic generalized gingivitis students were selected for the study followed by professional oral prophylaxis. The patients were asked to retain their regular oral hygiene practice with a 7 day revaluation phase. After 7 days, all the patients underwent periodontal examination which included probing pocket depth, gingival recession and clinical attachment level. 5 patients were excluded from the study as they were found to be periodontally unhealthy. Only the periodontally healthy patients (n=20) underwent a clinical oral examination performed by a single examiner, trained and calibrated to obtain the following initial clinical parameters: disclosed plaque index (DPI), gingival index (GI) and modified sulcular bleeding index (MSBI). Personalized instructions for toothbrushing were given individually and verbally according to the brush (STB). Only during the washout period, the subjects were encouraged to apply other conventional oral hygiene methods, such as dental floss or tape.

After 72 hours a second professional prophylaxis session was performed with a 3-day washout period. After the washout period, the volunteers were then assigned to the conventional toothbrush. GI, DPI and MSBI were recorded both at the beginning and at the end of each trial period.

Statistical analysis
Only the subjects who completed the study (n=20) were considered for statistical purposes. For intra-group analysis (between periods) of the data (GI, DPI and MSBI), student's t test was used. For inter-group analysis (between treaments), student's t test was used. For all the analyzes, the significance level was set at 5%.

Results
Intergroup analysis at the early experimental stage (T=0) revealed no statistically significant difference between both the treatments (STB, CT) for any of the evaluated parameters (DPI, GI, MSBI), demonstrating homogeneity between the groups. After 72 h (T=72) (Table 1), a significant difference was observed for all the parameters (p<0.05)

Table 1: Intergroup analysis at baseline and after 72 hours

Gingival index	Single tuft brush		Conventional tooth brush		t	p-value	95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Lower	Upper
Baseline	1.16	0.06	1.17	0.09	0.400	0.691	-0.04	0.06
72 hours	1.10	0.04	1.13	0.07	1.617	0.114	-0.01	0.07
Modified sulcular bleeding index	Single tuft brush		Conventional tooth brush		t	p-value	95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Lower	Upper
Baseline	1.19	0.11	1.19	0.11	0.000	1.000	-0.07	0.07
72 hours	1.12	0.09	1.15	0.10	1.013	0.318	-0.03	0.09
Plaque index	Single tuft brush		Conventional tooth brush		t	p-value	95% Confidence Interval of the Difference	
	Mean	SD	Mean	SD			Lower	Upper
Baseline	1.31	0.15	1.36	0.16	0.921	0.363	-0.05	0.14
72 hours	1.21	0.14	1.29	0.14	1.950	0.059	0.00	0.18
	Single tuft brush		Conventional tooth brush		t	p-value	95% Confidence Interval of the Difference	
Difference	Mean	SD	Mean	SD			Lower	Upper
Gingival index	0.07	0.06	0.04	0.09	-1.325	0.193	-0.08	0.02
Modified sulcular bleeding index	0.07	0.05	0.04	0.06	-1.790	0.081	-0.07	0.00
Plaque Index	0.11	0.05	0.06	0.05	-2.632	0.012	-0.08	-0.01

On intragroup comparison, the GI, MSBI, DPI showed improvement in both the groups at 72 hours. However, the improvement was statistically significant in the soft tuft brush as compared to the conventional brush. (Table 2a, 2b, 2c)

Table 2a: Intragroup comparision of Gingival index at baseline (T=0) and after 72 hours (T=72)

Gingival index	Single tuft brush	Conventional tooth brush
Baseline	1.16	1.17
72 hours	1.10	1.13

Mean Gingival index for the treatment at baseline (T=0) and after 72 hours (T=72) for single tuft and conventional toothbrush.

**Table 2b:** Intragroup comparision of modified gingival index at baseline (T=0) and after 72 hours (T=72)

Modified sulcular bleeding index	Single tuft brush	Conventional tooth brush
Baseline	1.19	1.19
72 hours	1.12	1.15

Mean modified sulcular bleeding index for the treatment at baseline (T=0) and after 72 hours (T=72) for single-tuft and conventional toothbrushes.

Table 2c: Intragroup comparision of disclosed plaque index at baseline (T=0) and after 72 hours (T=72)

| Plaque index	Single tuft brush	Conventional tooth brush
Baseline	1.31	1.36
72 hours	1.21	1.29

Mean disclosed plaque index for the treatment at baseline (T=0) and after 72 hours (T=72) for single tuft and conventional tooth brush
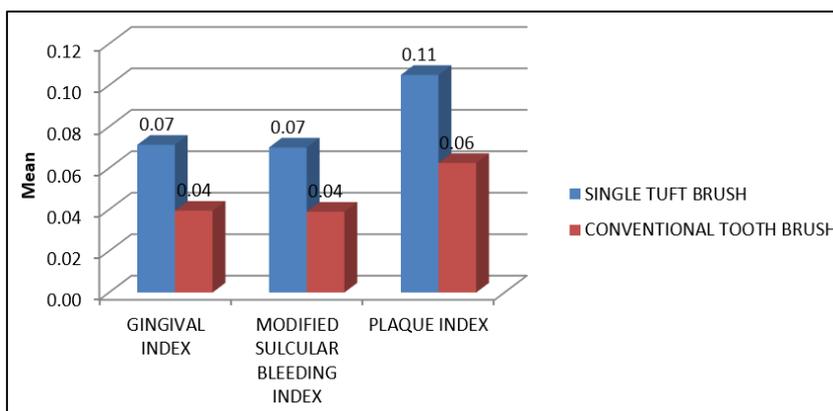
Comparative Mean of gingival index, disclosed plaque index and modified gingival index of the single tuft and conventional toothbrush.
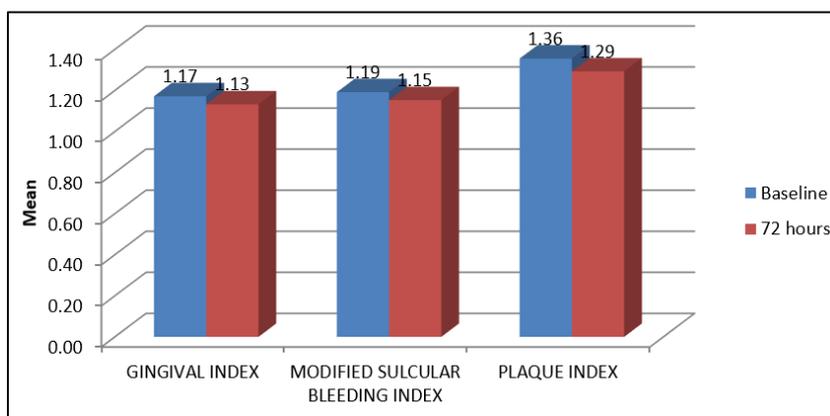
Mean for the clinical parameters at baseline (T=0) and after 72 hours for conventional toothbrush
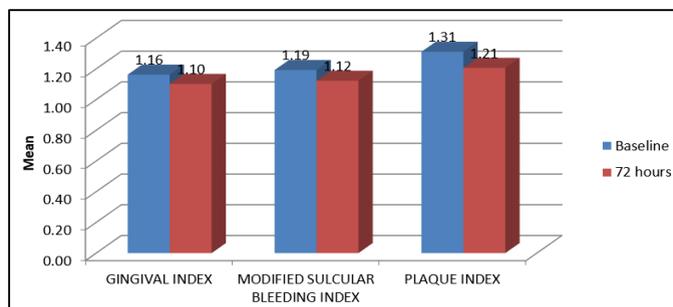
Mean for the clinical parameters at baseline (T=0) and after 72 hours for single tuft toothbrush

Conclusion

The present study aimed at evaluating the efficacy of single tuft toothbrush in the removal of dental plaque from hard to reach surfaces. Tooth brushing per se is often insufficient to remove dental plaque particularly from interproximal and dentogingival areas. The inclusion of washout periods minimized the residual effects of the methods used before each new treatment.[11-13]

Rapp and coworkers[14] compared the Bass technique using single-tuft brush alone or in combination with dental flossing in interproximal areas. They concluded histomorphometrically, the Bass technique and the combination of single-tuft brushes with floss yielded very similar results and slightly better than the Bass-floss combination, while the use of single tuft brushes without dental flossing showed poorer results. The findings from Rapp et al do not correlate those from the present study.

In a randomized, single-blind, controlled clinical trial[15] performed with orthodontic patients, subjects wearing lingual fixed appliances were asked to brush with triple-head toothbrush or an orthodontic brush alone for one month. Subsequently, they were instructed to brush in conjuction with a single-tuft toothbrush for an additional one month. Professional oral prophylaxis was performed at baseline and one month later. Similar to the present study, a positive effect of the single tuft brush: when used alone, the triple-head brush seemed to remove dental plaque more efficiently than the orthodontic toothbrush.

In general, the present study was able to demonstrate the short-term effectiveness of single-tuft toothbrushes.

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Conflict of interest
None.

References
1. Grover D, Malhotra R, Kaushal SJ, Kaur Gurpreet. Toothbrush 'A key to mechanical plaque control'. *Ind J Oral Sci* 2012;3(2):62-8.
2. Lang NP, Schatzle MA, Loe H. Gingivitis as a risk factor in periodontal disease. *J Clin Periodontol* 2009;36(Suppl 10):3-8.
3. Peruzzo DC, Gimenes JH, Taiete T, Casarin RC, Feres M, Sallum EA, et al. Impact of smoking on experimental gingivitis. A clinical, microbiological and immunological prospective study. *J Periodontal Res* 2016;3(10):1111.
4. Arweiler NB, Henning G, Reich E, Netuschil L. Effect of an amine-fluoride-triclosan mouthrinse on plaque regrowth and biofilm vitality. *J Clin Periodontol* 2002;29(4):358-63.
5. Bergenholtz A, Brithon J. Plaque removal by dental floss or tooth picks. An intra-individual comparative study. *J Clin Periodontol* 1980;7(6):516-24.
6. Lindhe J, Karring T, Lang NP. Clinical Periodontology and Implant Dentistry. 5 ed. Rio de Janeiro (RJ):Guanabara Koogan;2010.p.689.
7. Erovic Ademovski S, Lingstrom P, Winkel E, Tangerman A, Persson GR, Renvert S. Comparison of different treatment modalities for oral halitosis. *Acta Odontol Scand* 2012;70(3):224-33.
8. Ademovski SE, Persson GR, Winkel E, Tangerman A, Lingstrom P, Renvert S. The short-term effects on the microbiota at the dorsum of the tongue in intra-oral halitosis patients- a randomized clinical trial. *Clin Oral Investig* 2013;17(2):463-73.
9. Peruzzo DC, Jandiroba PF, Nogueira Fiho Gda R. Use of 0.1% chlorine dioxide to inhibit the formation of morning volatile sulphur compounds (VSC). *Braz Oral Res* 2007;21(1):70-4.
10. Salzer S, Slot DE, Dorfer CE, Van der Weijden GA. Comparison of triclosan and stannous fluoride dentifrices on parameters of gingival inflammation and plaque scores: a systemic review and meta-analysis. *Int J Dent Hyg* 2015;13(1):1-17.
11. Sharma NC, Qaqish J, Walters PA, Grender J, Biesbrock AR. A clinical evaluation of the plaque removal efficacy of five manual toothbrushes. *J Clin Dent* 2012;21(1):8-12.
12. Wilder RS, Bray KS. Improving periodontal outcomes: merging clinical and behavioral sciences. *Periodontol* 2000 2016;71(1):65-81.
13. Lee DW, Moon IS. The plaque-removing efficacy of a single-tufted brush on the lingual and buccal surfaces of the molars. *J Periodontal Implant Sci* 2011;41(3):131-4.
14. Rapp GE, Toledo BEC, Neto CB, Abi Rached RSG. Effect of the intracrevicular techniques by Bass and Unitufo with or without dental flossing on the interproximal gingiva: histomorphological analysis in humans. *Rev Odontol UNESP* 1997;26(2):325-26.
15. Ashkenazi M, Salem NF, Garon S, Levin L. Evaluation of orthodontic and triple-headed toothbrushes when used alone or in conjuction with single-tufted toothbrush in patients with fixed lingual orthodontic appliances: A randomized clinical trial. *N Y State Dent J* 2015;81(3):31-7.