Research Article

Evaluation of The Effectiveness of Some Tooth Brushing Techniques in Plaque Control Among Preclinical Dental Students in a Nigerian Tertiary Institution

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ABSTRACT

The Modified Bass Technique (MBT) of tooth brushing is the most effective in plaque removal compared to some other reported techniques like Fones, Scrub, Charters and Stillman. We hypothesize that there will be a greater plaque reduction using the MBT as compared to the other reported techniques. The aim of this study therefore is to determine the effectiveness of the MBT compared to other tooth brushing techniques in plaque control. A 28 day clinical trial amongst 50 preclinical dental students was done. Participants were randomized into two groups, MBT group and other preferred tooth-brushing methods group. Data was collected using a self-administered semi-structured questionnaire on sociodemographic, oral health habits and knowledge on brushing techniques. The oral examinations were done by two calibrated examiners. Simplified Oral Hygiene Index (OHI-S), percentage plaque score and gingival bleeding score were recorded. The examiners and data analyst were blinded and data analysis was done using Paired T test with statistical significance of p< 0.05. Significant reduction was found in facial and interproximal plaque scores for both groups but more in the MBT group. There was significant reduction in gingival bleeding on probing in the MBT group after seven days while this was not significant in the other group (p>0.05). However, after 28 days, there was significant reduction in bleeding on probing in both groups. Within the limitations of this study, we found the Modified Bass Technique of tooth brushing to be more effective in plaque control compared to other brushing techniques..

INTRODUCTION

"Periodontal health can be defined as a state in which an individual is free from inflammatory periodontal diseases, such that he/she can function normally and avoid consequences (mental or physical) of the diseases either due to current or past episodes" (Chapple *et al*., 2018). Periodontal health may also be defined as absence of gingivitis, periodontitis or other periodontal conditions with the individuals being able to maintain their dentition without signs of gingival inflammation (Chapple *et al*., 2018).

Within 7-21 days without tooth brushing, gingival inflammation which is often the first sign of an unhealthy periodontium is induced mainly by the accumulation of microbial plaque biofilm which plays a prominent role in the etio-pathogenesis of periodontal diseases (Lindhe *et al*., 2010;

Hasan *et al*., 2014; Newman *et al*., 2018). Therefore, in order to achieve healthy periodontium, it is essential to have an effective plaque control regimen on a daily basis. Plaque control methods can be broadly categorized into mechanical and chemical, with reports that mechanical control methods are far more effective than the chemical and that the chemical only serves as an adjunct (Newman *et al*., 2011). These mechanical control methods include tooth brushing and interdental cleaning.

Effective daily tooth brushing reduces microbial plaque biofilm accumulation which is dependent on several factors which include the toothbrush design, duration of brushing, the frequency of brushing, the technique used and the individual's manual dexterity. Several brushing techniques have been described, with various studies reporting the bass or modified bass technique (MBT) as being more effective (Poyato *et al*.,

2003; Hagberg *et al.*, 2007; Gibson *et al.*, 2013; Nassar *et al.*, 2013), while some reported other techniques like fones, horizontal scrub, charters and stillman as more effective (Arai *et al.*, 1977; Harnacke *et al.*, 2016). Robinson *et al* (1976) however reported that there was no significant difference between bass and horizontal scrub. In a recent systematic review and meta-analysis (Janakiram *et al.*, 2018), it was reported that modified bass technique was more capable of removing plaque than the scrub tooth brushing techniques but it had some limitations of insufficient data and vast heterogeneity within the selected studies reviewed.

Globally, it has been reported that no single tooth brushing technique adequately cleans occlusal pits, fissures and interproximal areas of the teeth, though there seems to be a consensus agreement that the bass technique is effective in cleaning the sulcus and subgingival areas (Baruah *et al.*, 2017). A study of tooth brushing trends in 20 countries in Europe and North America from 1994 to 2010 revealed that a largely positive trend was brushing twice daily was observed across all the countries studied with the younger age groups showing more potential of oral hygiene improvement from oral health education (Honkala *et al.*, 2015). Local studies on brushing techniques have been majorly descriptive, Oginni *et al* (2013) in a study amongst Obafemi Awolowo University Undergraduates, reported 73% of the respondents brush only once daily. The study further reported 52%, 37% and 11% of respondents used vertical (up and down), horizontal (side by side) and circular brushing techniques respectively. There is paucity of controlled experimental studies within our environment to objectively compare the effect of these various brushing techniques on plaque removal.

The role of dental professionals in oral health education cannot be overemphasized, hence we set out to conduct our study among dental students bearing in mind their role as future oral health care providers, its important for them to understand and appreciate the differences in the various brushing techniques in other to provide oral health education for the population. The aim of this study therefore is to determine the effectiveness of the modified bass technique in removing plaque compared to other tooth brushing techniques.

MATERIALS AND METHODS

Study design

This study was a 28-day follow-up study carried out at the Dental Centre, University College Hospital from January to February 2019. Ethical approval was obtained from the institutional ethical review committee.

Participants

Preclinical dental students of the University of Ibadan who were in their 2nd stage preclinical but not yet in the clinical stage were recruited for the study. They therefore haven't had lectures on clinical subjects in dentistry including Periodontology and Community dentistry.

Participants were excluded if they had orthodontic appliances, dentures and other dental prostheses; teeth crowding ; fewer than 6 natural teeth in each quadrant; periodontal pocket 4mm. Participants had to give inform consent before being recruited into the study.

Sample size:

The sample size was calculated using the formula for comparative study (Kirkwood *et al.*, 2003)

$$N= \frac{\{Z\beta + Z\}2\{12 +22\}}{(2-1)2}$$

Where

N=minimum sample size

Zα= standard normal deviate corresponding to the probability of type 1 error (α) at 5%==1.96

Zβ=standard normal deviate corresponding to probability of making type II error (β) of 20%.

Power at 80%=0.84

The mean and standard deviation used for determining the sample size were obtained from a previous study by Giri *et al* (2018). Adjustment was made for a 7.5% attrition rate. Minimum sample size is 25 participants per group.

A total of 64 students were eligible for this study, 12 were excluded because they did not meet the inclusion criteria and 2 students did not give informed consent. A total sampling of 50 students were recruited into the study.

Randomization

Participants were randomized into two different groups by simple balloting. They were asked to draw a paper from a bag containing 25 "Yes" and 25 "No" written on them. Individuals who picked "Yes" were randomized into the modified bass technique method and those who picked "No" were randomized into the other tooth brushing techniques which were the techniques that they were using prior to the commencement of the study.

Blinding

Participants could not be blinded to the technique that they were randomized to, but the examiners and data analyst were blinded and they were not aware of the technique each participant was assigned

Data collection

Data was collected using a semi-structured questionnaire with questions asked on sociodemography, oral health habits, and knowledge on brushing techniques. The oral examination of the participants was carried out by two calibrated examiners whose inter-examiner agreement was measured with kappa statistic to be 0.89. Simplified Oral Hygiene Index (OHI-S) was recorded (Greene *et al.*, 1964), percentage plaque score was also recorded using Turesky's modification of Quigley and Hein (Quigley *et al.*, 1962; Turesky *et al.*, 1970) and the percentage bleeding score was recorded using the Ainamo and Bay method (Trombelli *et al.*, 2018).

Procedure

Participants were all given the same medium textured toothbrush and fluoridated toothpaste before the commencement of the study. All Participants were instructed to brush their teeth for 5 minutes duration twice daily before breakfast and after dinner.
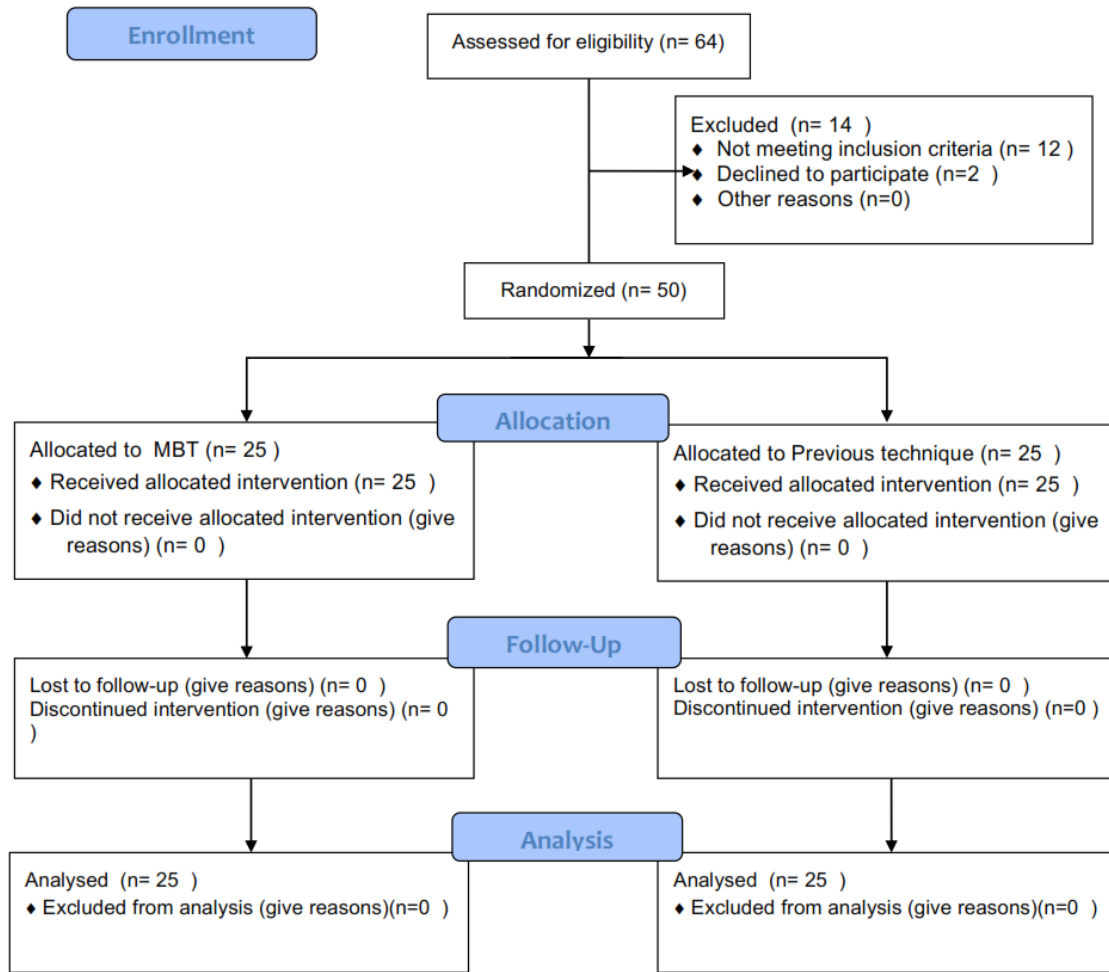
Figure 1:
Flow Diagram of study

They were instructed not to use any other form of plaque control method especially chemical control during the period of their participation in the study.

All participants had prophylactic scaling and polishing before the commencement of the study and they were told to abstain from all oral hygiene measures for 48 hours after which the baseline plaque and percentage bleeding on probing scores were recorded. Participants were given plaque disclosing tablets to chew, mix it with saliva and swish the saliva around the mouth for about 30 seconds and spit it out. The presence of plaque was denoted by either a red (plaque < 12 hours) or blue (plaque > 12 hours) stain. Plaque and gingival bleeding scores were recorded for four tooth/gingival surfaces per tooth (mesial, distal, facial/buccal and lingual/palatal) available excluding the third molar, the overall percentage plaque score was determined by dividing the total plaque score obtained by the total number of surfaces available (this is also done to obtain the bleeding score).

Those in the other tooth brushing group were instructed to continue with the techniques that they were using prior to their recruitment into the study. Those in the MBT group were taught the technique of MBT all together at the same time with the aid of a video and dental model, hands on by all participants was thereafter carried out to confirm that they all understood the MBT properly.

Data analysis
Plaque and gingival bleeding scores were expressed as mean SD. Plaque and Gingival bleeding scores were calculated for the whole mouth, plaque score was also calculated for the facial and interproximal surfaces of the mouth for all participants. The comparison of percentage reduction was carried out using Paired t test for within the group changes in the plaque control comparing baseline with 7 days and baseline with 28 days, with statistical significance established at $P < 0.05$ level.

RESULTS

The mean age of the participants was 23.10 ± 1.77 and male to female ratio was 2:3. Eighty two percent of the participants were of Yoruba tribe and 74% were Christians. Only 34% of the participants brush twice daily prior to inclusion in the study. Over half of the participants (56%) have never visited the dentist before. (Table 1).

Table 1
Oral Hygiene and Tooth Brushing Variables

Variables	Frequency (%) N= 50
Teeth cleaning	
Once daily	33 (66)
Twice daily	17 (34)
Brush texture	
Hard	6 (12)
Medium	33 (66)
Soft	11 (22)
Interdental cleaning	
Yes	34 (68)
No	16 (32)
Interdental cleaning device used (N=34)	
Floss	20 (58.8)
Interdental brush	5 (14.7)
Toothpick	7 (20.6)
Others	2 (5.9)
Dental visit	
Never	28 (56)
Twice per year	4 (8)
Once per year	8 (16)
Once in 2 years	4 (8)
Others	6 (12)
Brushing techniques awareness	
Yes	38 (76)
No	12 (24)
Brushing technique used	
Roll	16 (32)
Vertical	11 (22)
Scrub	19 (38)
Bass	1 (2)
Horizontal	1 (2)
Haphazard	2 (4)

The mean OHI-S of the participants was 1.78± 0.54, with males having significantly higher mean OHI-S scores and those who have never visited the dentist before also having significantly higher mean OHI-S scores. (Table 2)

Both groups showed a significant mean reduction in the plaque scores, with a 43% reduction in the total plaque score of participants using the MBT compared to a 28.5% reduction in those using other brushing techniques after 28 days (Table 3). Significant reduction was also observed in the overall facial and interproximal plaque scores. There was a 48% and 30% reduction in facial plaque scores for both MBT and the other group respectively after 28 days while there was a 36% and 27% reduction in interproximal plaque scores in MBT and the other group respectively. Overall, there was more reduction of the facial plaque compared to the interdental plaque with a greater reduction in the MBT group compared

to the other group. (Table 3). There was no significant reduction in gingival bleeding on probing in participants using the other tooth brushing techniques after 7 days (p > 0.05) as opposed to that found in those using MBT. After 28 days however, there was significant reduction in bleeding on probing in both techniques and MBT group had a reduction of 42% compared to 29% seen in the other group (Table 4). Plates 1 and 2 are representative pictures of participants showing their dental situations at onset and during the study.

Table 2:
Association between Oral Health Habits and OHI-S

Variables	Mean OHI-S (SD)	P value
Gender		
Male	1.96 (0.58)	0.045*
Female	1.65 (0.48)	
Teeth cleaning		
Once	1.87 (0.57)	0.12
Twice	1.61 (0.45)	
Brush texture		
Medium	1.73 (0.46)	0.452
Others	1.86 (0.69)	
Interdental cleaning		
Yes	1.81 (0.56)	0.586
No	1.71 (0.51)	
Dental visit		
Never	1.90 (0.51)	0.047*
Yes	1.62 (0.55)	

Significant at p < 0.05

Plate 1
This individual was randomized to the modified bass technique group. A, B and C were taken at baseline, 7 days and 28 days respectively.

Plate 2
This individual was randomized to the previous technique he was using. A, B and C were taken at baseline, 7 days and 28 days respectively.

Table 3:
Mean Plaque Score for all Surfaces, Buccal and Lingual, Interproximal

Examination	All surfaces		Buccal and lingual		Interproximal	
Mean plaque score	Others	MBT	Others	MBT	Others	MBT
Baseline	33.07 (10.39)	37.43 (14.25)	38.57 (15.31)	44.64 (17.07)	27.57 (18.60)	30.21 (17.33)
7th day	28.14	29.24*	31.43	32.71*	24.85	25.78*
28th day	23.64	21.19*	27.07	23.14*	20.21	19.23*

Difference within MBT group is significantly lower than the normal tooth brushing technique (p <0.01)

Table 4:
Mean Gingival Bleeding Score for all Surfaces

Examination	All surfaces	
Mean Bleeding score	Others	MBT
Baseline	6.99 (5.32)	6.96 (5.24)
7th day	6.14^	5.71*
28th day	4.93**	4.03**

^ *No Significant difference with baseline (p > 0.05)*   **Significant P < 0.05   **Significant P < 0.01*

DISCUSSION

Several brushing techniques have been developed and taught over the years. Amongst our participants, the commonest brushing technique used was the scrub followed by roll and vertical. The scrub method is a combination of the horizontal, vertical and circular strokes. These methods are often effective for removal of plaque on the smooth surfaces of the tooth, and are less effective in removal of plaque around the gingival margin.

Results from our study is similar to those reported by other studies on the efficacy of modified bass technique (Poyato *et al*., 2003; Hagberg *et al*., 2007; Gibson *et al*., 2013; Nassar *et al*., 2013) in plaque removal and it lends further credence to the systematic review carried out by Janakiram *et al* (2018). Poyato *et al* (2003) reported significant reduction only among those using MBT, while in our own study we found significant reduction in both MBT and other techniques used before recruitment into the study. Poyato *et al* (2003) also reported a mean percentage reduction in plaque score of 2.9 fold increase in those using MBT while we reported a 1.5 fold increase in mean percentage reduction in total plaque. Our study was carried out among dental students, while Poyato *et al* (2003) carried out theirs among secondary school students, with far greater interaction and curiosity among them which could lead to exchange of information among the individuals in both groups hence leading to lesser fold increase observed in our study.

We found a significant reduction in the plaque levels in both MBT and the other techniques which the participants have being using. Although the reduction achieved in this study after 28 days using both techniques is still well below the 10% expected reduction , this might be due to this study participants not yet totally adept at using the MBT as it takes time to learn new habits, perhaps with time there will be a mastery of the technique which will then lead to further plaque reduction.

Our study participants had a greater success in removing the facial plaque compared to the interproximal plaque. Those using MBT also had greater plaque reduction in facial and interproximal areas compared to other group. Although MBT alone had significantly reduced plaque accumulation, it is more effective if it is used in conjunction with interdental cleaning aids, without which it may be difficult to achieve a plaque score not exceeding 10%. About 70% of the participants claimed to clean their teeth interdentally with almost 60% of them claiming to use floss, yet there was a significantly lesser percentage reduction in interproximal

plaque. Highly effective flossing depends on proper technique (Cepeda *et al*., 2017), and the participants were not asked to demonstrate how well they flossed, this is might be a possible explanation for our observation. It often takes about 7-21 days for an inflamed gingiva to revert back to health in the absence of continuous plaque irritation. The significant reduction in bleeding on probing by the MBT after 7 days as compared to the normal technique is perhaps due to the ability of the technique to insert the bristles into the sulcular area with gentle vibratory movements and rolling it outwards after (Lindhe *et al*., 2010).

Some other possible explanations for our result include the tendency of individuals to behave differently when they are being studied known as Hawthorne effect. We may also not rule out increased motivation of the participants with the oral hygiene instructions. These explanations may pose a threat to the internal validity of this study.

In conclusion, this study shows that the Modified Bass Technique is more effective in plaque control compared to other brushing techniques, even though the technique may require some time to get acquainted to, it is still more beneficial.. Individuals should also be encouraged to clean interdentally using the appropriate Interdental cleaning aids..

REFERENCES

Arai, T. and Kinoshita, S. (1977) 'A comparison of plaque removal by different toothbrushes and toothbrushing methods', *The Bulletin of Tokyo Medical and Dental University*, 24(2), pp. 177–188.

Baruah, K. et al. (2017) 'A Review on Toothbrushes and Tooth Brushing Methods', 6(5), pp. 29–38.

Cepeda, M. S. et al. (2017) 'Association of flossing / inter- -dental cleaning and periodontitis in adults', (June), pp. 866–871. doi: 10.1111/jcpe.12765.

Chapple, I. L. C. et al. (2018) 'Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: Consensus report of workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions', *Journal of Clinical Periodontology*, 45(December 2017), pp. S68–S77. doi: 10.1111/jcpe.12940.

Gibson, J. A. and Wade, A. B. (2013) 'Plaque Removal by the Bass and Roll Brushing Techniques', *Journal of Periodontology*, 48(8), pp. 456–459. doi: 10.1902/jop.1977.48.8.456.

Giri, D. (2018) 'Effectiveness between two tooth brushing methods on removing dental plaque', *Journal of Nobel Medical College*, 7(1), pp. 26–29. doi: 10.3126/jonmc.v7i1.20843.

Greene, J. and Vermillion, J. (1964) 'The Simplified Oral Hygiene Index', *The Journal of the American Dental Association*, 68, pp. 1–7. doi: 10.14219/jada.archive.1964.0034.

Hagberg, C. et al. (2007) 'Role of brushing technique and toothbrush design in plaque removal', *European Journal of Oral Sciences*, 92(4), pp. 344–351. doi: 10.1111/j.1600-0722.1984.tb00901.x.

Harnacke, D. et al. (2016) 'Training in different brushing techniques in relation to efficacy of oral hygiene in young adults: A randomized controlled trial', *Journal of Clinical Periodontology*, 43(1), pp. 46–52. doi: 10.1111/jcpe.12489.

Hasan, A. and Palmer, R. M. (2014) 'A clinical guide to periodontology: Pathology of periodontal disease', *British Dental*

Journal. Nature Publishing Group, 216(8), pp. 457–461. doi: 10.1038/sj.bdj.2014.299.

Honkala, S. *et al.* **(2015)** 'Trends in toothbrushing in 20 countries / regions from 1994 to 2010', 25, pp. 20–23. doi: 10.1093/eurpub/ckv013.

Janakiram, C., Taha, F. and Joe, J. (2018) 'The efficacy of plaque control by various toothbrushing techniques-a systematic review and meta-analysis', *Journal of Clinical and Diagnostic Research*, 12(11), pp. 1–6. doi: 10.7860/JCDR/2018/32186.12204.

Kirkwood, B. and Sterne, J. (2003) 'Calculation of required sample size', in *Essential Medical statistics*. 2nd ed, pp. 413–428. doi: 10.1002/sim.1961.

Lindhe, Jan; Lang, N. P. (2010) *Clinical Periodontology and Implant Dentistry, 5th Edition*.

Nassar, C. A. *et al.* **(2013)** 'Periodontal evaluation of different toothbrushing techniques in patients with fixed orthodontic appliances', *Dental Press Journal of Orthodontics*, 18(1), pp. 76–80. doi: 10.1590/s2176-94512013000100017.

Newman, M. *et al.* **(2011)** *Carranza's Clinical Periodontology*.

Newman, M. *et al.* **(2018)** *Newman and Carranza's Clinical Periodontology*. 13th edn. Elsevier.

Oginni, F. and Oginni, A. (2013) 'A study of tooth brushing pattern and its effects on dental tissues in Obafemi Awolowo University students', (January).

Poyato, M., Segura, J. and Bullón, P. (2003) 'Comparison of modified Bass technique with normal toothbrushing practices for efficacy in supragingival plaque removal.', *International journal of dental hygiene*, 1(2), pp. 110–114. doi: 10.1034/j.1601-5037.2003.00018.x.

Quigley, G. and Hein, J. (1962) 'Comparative cleansing efficiency of manual and power brushing.', *Journal of the American Dental Association (1939)*, 65(1), pp. 26–29. doi: 10.14219/jada.archive.1962.0184.

Robinson, E. (1976) 'A comparative evaluation of the scrub and bass methods of toothbrushing with flossing as an adjunct (in fifth and sixth graders)', *American Journal of Public Health*, 66(11), pp. 1078–1081. doi: 10.2105/AJPH.66.11.1078.

Trombelli, L. *et al.* **(2018)** 'Plaque-induced gingivitis: Case definition and diagnostic considerations', *Journal of Clinical Periodontology*, 45(September 2017), pp. S44–S67. doi: 10.1111/jcpe.12939.

Turesky, S., Gilmore, N. and Glickman, I. (1970) 'Reduced Plaque Formation by the Chloromethyl Analogue of Victamine C', *Journal of Periodontology*, 41(1), pp. 41–43. doi: 10.1902/jop.1970.41.1.41.