

Clinical and Microbiological Evaluation of Manual Toothbrush, Electric Toothbrush and Nano-b Toothbrush on Plaque Removing Efficacy among Visually Impaired Children: A Randomised Clinical Trial

AR JAYA¹, KALYANI MAGANDAS CHOUDHAR²

ABSTRACT

Introduction: Oral hygiene can be maintained by mechanical and chemical methods. Maintenance of oral hygiene is challenging in visually impaired children due to physical limitations.

Aim: To compare plaque removal efficacy using different toothbrushes among visually impaired children.

Materials and Methods: This randomised clinical trial conducted on 45 visually impaired children aged between 7-12 years from a blind school in Bengaluru, Karnataka, India, after obtaining informed consent. Study was conducted in the month of September 2020 and October 2020 for a period of two months. All potential participants were randomly divided into three groups depending on the type of toothbrush used. A plaque disclosing agent (Alpha Plac) was applied and Turesky Modified Quigley Hein Plaque Index (TQHPI) was recorded for all subjects on 15th, 30th, 45th and 60th day from the baseline. Plaque samples were collected from all the subjects and microbial assessment was done for detection of Colony Forming Units (CFUs), on 30th and 60th day from the baseline. Data was analysed using One-way

Analysis of Variance (ANOVA) test followed by Tukey's post-hoc analysis at baseline and post interventional time periods. Friedman's test followed by Wilcoxon's Signed Rank post-hoc analysis was used to compare mean CFUs between different time intervals, in each study group.

Results: At baseline, no statistically significant difference was noted between the three groups with respect to TQHPI and CFUs. At two months follow-up, nano-b toothbrush group showed significant decrease in mean Plaque Index (PI) score compared to electric toothbrush group (p-value=0.01) and manual toothbrush group (p-value <0.001). Similarly, at two months, mean reduction in CFUs was greater in nano-b toothbrush group followed by electric toothbrush group and manual toothbrush group which was statistically significant (p-value=0.003).

Conclusion: Plaque removal efficacy in visually impaired children was superior in nano-b toothbrush group, followed by electric toothbrush group and manual toothbrush group in succession, respectively.

Keywords: Colony forming units, Dental plaque, Oral hygiene, Turesky modified quigley hein plaque index

INTRODUCTION

Dental plaque is a biofilm of micro-organisms which grows on all surfaces of teeth which is sticky, colourless and hence, its progression and build up can give rise to tooth decay and periodontal diseases. Maintenance of oral hygiene and removal of dental plaque can be achieved both by mechanical and chemical methods. Toothbrushing is the simplest and most effective method for plaque removal, prevention of caries and periodontal diseases [1]. First true bristled toothbrush originated in China, in around 1600 AD. Electric toothbrush was invented by Dr. Philippe Guy Woog in the 1960s [2]. Electric toothbrush has definite use for children with special healthcare needs to overcome their limitations which could either be physical, psychological or systemic [3].

As dentistry is continuously evolving with respect to technology and introduction of newer materials with better properties, in the last decade, there has been increased use of nanoparticles in consumer products due to their distinctive properties and wide range of applications. Bristles are coated with gold and charcoal nanoparticles. Nano-b antibacterial toothbrushes reduce bacteria both in the mouth and on the toothbrush and help to brighten the smile [1].

Maintenance of proper oral hygiene is difficult in disabled individuals because of psychological and physical limitations, especially in visually impaired children. Children with visual impairment have

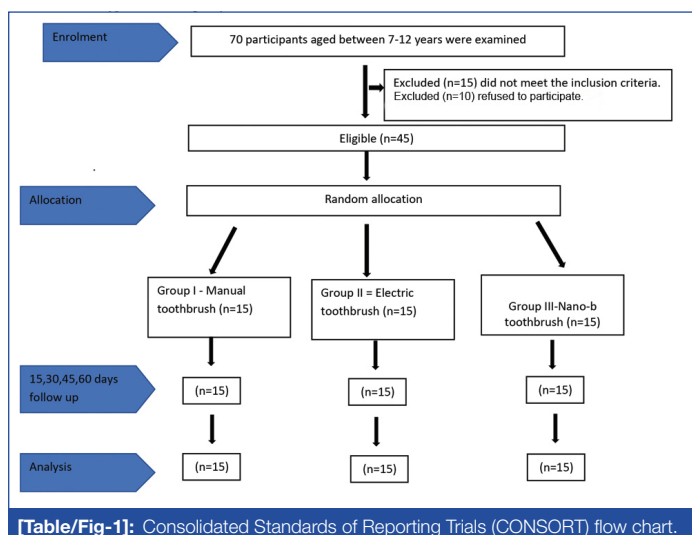
a limitation to visualise presence of debris and calculus and also difficult to teach proper oral hygiene practices to them which, in turn, leads to inadequate removal of plaque and increased prevalence of dental caries and periodontal diseases [4].

It is necessary to assess oral health needs and demands of this disadvantaged population so as to set plans and policies for oral health programs. There are several studies that compared manual with powered toothbrushes and manual with sonic/ultrasonic toothbrushes [2,3]. However, there were no studies reported in literature that compared latest nano-b toothbrush with manual and electric toothbrush in visually impaired individuals. Hence, the present study was undertaken to assess clinically and microbiologically, plaque removal efficacy of manual, electric and nano-b toothbrushes.

MATERIALS AND METHODS

This randomised clinical trial conducted on 45 visually impaired children aged between 7-12 years, from a blind school in Bengaluru, Karnataka, India. Study was conducted in the month of September 2020 and October 2020 for a period of two months. Trial was registered with the Clinical Trial Registry of India (CTRI/2020/11/029123). Study was approved by the Institutional Ethics Committee (RRDCET/03PEDO/2018). Informed consent was taken from the school authorities. Before commencement of the study, informed consent was obtained from the child's parent/

guardian. Estimated sample size was 45 using GPower software version 3.1.9.2. Schematic representation of randomisation and allocation is shown in [Table/Fig-1].



Inclusion criteria: Children with general good health except visual impairment, minimum of 20 scorable teeth and with Decayed, Missing, and Filled Teeth (DMFT) index score <3.

Exclusion criteria: Children with systemic diseases, on antibiotics four weeks prior to start of study and children with orthodontic appliances or removable prosthesis were excluded from the study. All potential participants were selected and randomly divided into three groups:

Group I (Control group) (n=15): Subjects using Manual toothbrushes (Colgate zigzag).

Group II (Test group 1) (n=15): Subjects using electric toothbrushes (Oral-B electric).

Group III (Test group 2) (n=15): Subjects using nano-b toothbrushes (Oraguard nano-b Gold and Charcoal).

Study Procedure

A plaque disclosing agent (Alpha Plac) was applied and plaque index was recorded using TQHPi [Table/Fig-2] [5]. Baseline plaque samples were collected from all the subjects using Gracey curette and transported in Eppendorf tubes containing 0.3 mL saline. Samples were transferred to culture media (blood agar) with the help of sterile platinum loop in a streaky manner and incubated at 37°C temperature maintained [6]. Microbial assessment was done for detection of CFU from the plaque samples [Table/Fig-3].

All the subjects were provided with respective toothbrushes [Table/Fig-4]. Same type of toothpaste was used by all the subjects during the entire examination period. Oral hygiene instructions were given to the patients regarding use of toothbrushes. Participants were asked to brush their teeth twice daily for two mins using horizontal scrub brushing technique. Horizontal scrub method is suitable for

large number of students in the school because this technique shows effectively plaque removal and requires less time to teach [7]. Mean plaque index using disclosing agent (Alpha Plac) was recorded at baseline and four postinterventional time periods (15th, 30th, 45th and 60th day) between the three groups (T1: 15th day, T2: 30th day, T3: 45th day, T4: 60th day). Microbiological tests to evaluate mean CFUs were performed at baseline and two post interventional time periods (30th and 60th day) between three groups.

STATISTICAL ANALYSIS

Statistical Package for Social Sciences (SPSS) for Windows version 22.0 was used to perform statistical analyses. Level of significance was set at p-value <0.05. One-way Analysis of Variance (ANOVA) test followed by Tukey's post-hoc analysis was used to compare the mean plaque index and mean CFUs at baseline and post interventional time periods between the three groups. Repeated measures of ANOVA followed by Bonferroni's Post-hoc analysis was used to compare the mean plaque index scores and mean CFUs between baseline and post interventional time periods in each study group. Friedman's test followed by Wilcoxon's Signed Rank post-hoc analysis was used to compare mean CFUs between different time intervals in each study group.

RESULTS

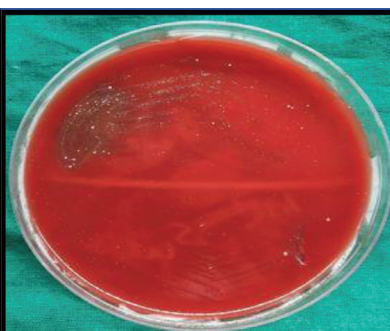
Out of 45 participants, 24 were males and 21 were females. Mean age of the participants was 9.60±1.77 years. [Table/Fig-5] illustrates mean TQHPi scores between three study groups at different time intervals.

No statistically significant difference was observed in mean TQHPi scores at baseline and T1 time interval between three groups. Though TQHPi scores showed a decreasing trend over the study period it was found to be statistically significant only at T2, T3 and T4 time intervals. Comparison of mean plaque index scores between three study groups at different time interval using one-way ANOVA test followed by Tukey's post-hoc analysis revealed that nano-b toothbrush group showed significantly lesser plaque index scores followed by electric toothbrush group (p-value=0.01) and manual toothbrush group (p-value <0.001) in succession respectively. At T4 time interval, electric toothbrush group showed significantly lesser mean plaque index score compared to manual toothbrush group (p-value=0.02).

[Table/Fig-6] illustrates mean TQHPi scores at different time intervals in manual toothbrush group. Multiple comparison of mean difference in plaque index scores using Bonferroni's post-hoc test revealed statistically significant reduction from baseline to different time intervals (p-value <0.001). However, no significant difference was noted between T3 and T4 time interval (p-value=0.08).

[Table/Fig-7] illustrates mean TQHPi scores at different time intervals in electric toothbrush group. Multiple comparison of mean difference in plaque index scores using Bonferroni's post-hoc test showed statistically significant reduction from baseline to different time intervals (p-value <0.001).

[Table/Fig-8] illustrates mean TQHPi scores at different time intervals in nano-b toothbrush group. Multiple comparison of mean difference in Plaque Index scores using Bonferroni's post-hoc test



[Table/Fig-2]: Colour change after application of plaque disclosing solution. **[Table/Fig-3]:** Culture media showing CFUs. **[Table/Fig-4]:** Electric toothbrush, nano-b toothbrush and manual toothbrush. (Images from left to right)

Time	Groups	N	Mean	SD	Minimum	Maximum	p-value ^a	Significant difference	p-value ^b
Baseline	Group I	15	1.59	0.38	0.8	2.1	0.61	Group I vs II	-
	Group II	15	1.67	0.32	1.2	2.2		Group I vs III	-
	Group III	15	1.51	0.59	0.5	2.3		Group II vs III	-
T1 (15 th day)	Group I	15	1.37	0.35	0.6	1.8	0.15	Group I vs II	-
	Group II	15	1.45	0.32	0.9	2.0		Group I vs III	-
	Group III	15	1.18	0.47	0.4	1.8		Group II vs III	-
T2 (30 th day)	Group I	15	1.23	0.34	0.5	1.7	0.02*	Group I vs II	0.91
	Group II	15	1.17	0.33	0.5	1.8		Group I vs III	0.03*
	Group III	15	0.89	0.37	0.3	1.4		Group II vs III	0.07
T3 (45 th day)	Group I	15	1.06	0.33	0.4	1.6	0.006*	Group I vs II	0.68
	Group II	15	0.96	0.35	0.3	1.5		Group I vs III	0.006*
	Group III	15	0.67	0.30	0.2	1.0		Group II vs III	0.04*
T4 (60 th day)	Group I	15	0.97	0.34	0.3	1.5	<0.001*	Group I vs II	0.02*
	Group II	15	0.66	0.32	0.1	1.0		Group I vs III	<0.001*
	Group III	15	0.34	0.17	0.1	0.6		Group II vs III	0.01*

[Table/Fig-5]: Comparison of mean plaque index scores between three study groups at different time intervals.

a) p-value derived by one-way ANOVA, b) p-value derived by Tukey's post-hoc analysis

Statistical test: One-way ANOVA followed by Tukey's post-hoc analysis, (Since the first p-value at baseline and T1 was not statistically significant, post-hoc test was not done.)

(I) Time	(J) Time	Mean difference (I-J)	95% CI for the difference		p-value
			Lower	Upper	
Baseline	T1	0.21	0.14	0.28	<0.001*
	T2	0.36	0.27	0.45	<0.001*
	T3	0.53	0.40	0.65	<0.001*
	T4	0.62	0.50	0.74	<0.001*
T1	T2	0.15	0.10	0.19	<0.001*
	T3	0.31	0.23	0.40	<0.001*
	T4	0.41	0.29	0.52	<0.001*
T2	T3	0.17	0.10	0.24	<0.001*
	T4	0.26	0.15	0.37	<0.001*
T3	T4	0.09	-0.01	0.19	0.08

[Table/Fig-6]: Multiple comparison of mean difference in plaque index scores between different time intervals in manual toothbrush group.

Statistical test-Bonferroni's post-hoc test. CI: Confidence interval

(I) Time	(J) Time	Mean difference (I-J)	95% CI for the difference		p-value
			Lower	Upper	
Baseline	T1	0.33	0.08	0.59	0.007*
	T2	0.63	0.36	0.89	<0.001*
	T3	0.85	0.53	1.16	<0.001*
	T4	1.17	0.77	1.58	<0.001*
T1	T2	0.29	0.16	0.43	<0.001*
	T3	0.51	0.33	0.70	<0.001*
	T4	0.84	0.56	1.12	<0.001*
T2	T3	0.22	0.15	0.29	<0.001*
	T4	0.55	0.36	0.74	<0.001*
T3	T4	0.33	0.20	0.46	<0.001*

[Table/Fig-8]: Multiple comparison of mean difference in plaque index scores between different time intervals in nano-b toothbrush group.

Statistical test-Bonferroni's post-hoc test. CI: Confidence interval

(I) Time	(J) Time	Mean difference (I-J)	95% CI for the difference		p-value
			Lower	Upper	
Baseline	T1	0.22	0.13	0.31	<0.001*
	T2	0.50	0.35	0.65	<0.001*
	T3	0.71	0.51	0.92	<0.001*
	T4	1.01	0.76	1.26	<0.001*
T1	T2	0.28	0.18	0.38	<0.001*
	T3	0.49	0.34	0.64	<0.001*
	T4	0.79	0.58	1.01	<0.001*
T2	T3	0.21	0.12	0.30	<0.001*
	T4	0.51	0.31	0.72	<0.001*
T3	T4	0.30	0.14	0.46	<0.001*

[Table/Fig-7]: Multiple comparison of mean difference in plaque index scores between different time intervals in electric toothbrush group.

Statistical test-Bonferroni's post-hoc test. CI: Confidence interval

revealed statistically significant reduction from baseline to different time intervals (p-value <0.001).

[Table/Fig-9] illustrates comparison of mean CFUs between three study groups at different time intervals using Kruskal-Wallis test followed by Mann Whitney's post-hoc analysis. Mean CFUs

Time	Groups	N	Mean	SD	Min	Max	p-value ^a	Significant difference	p-value ^b
Baseline	Group I	15	4540.00	4620.11	100	10000	0.78	Group I vs II	-
	Group II	15	5140.00	4711.05	100	10000		Group I vs III	-
	Group III	15	5740.00	4719.23	100	10000		Group II vs III	-
T2	Group I	15	508.00	477.29	10	1000	0.46	Group I vs II	-
	Group II	15	448.00	467.49	10	1000		Group I vs III	-
	Group III	15	268.00	380.12	10	1000		Group II vs III	-
T4	Group I	15	68.00	46.94	0	100	0.003*	Group I vs II	0.02*
	Group II	15	26.00	38.51	0	100		Group I vs III	0.004*
	Group III	15	18.67	33.35	0	100		Group II vs III	0.87

[Table/Fig-9]: Comparison of mean CFUs between three study groups at different time intervals.

Statistical test; ^a: Kruskal-Wallis test; ^b: Mann Whitney's post-hoc analysis

at baseline and T2 time intervals did not show any statistically significant difference. At T4 time interval, reduction in mean CFUs

was greatest in nano-b toothbrush group and showed statistically significant difference (p -value=0.003) followed by electric toothbrush group and manual toothbrush group. However, reduction in mean CFUs between electric and nano-b toothbrush group did not show statistically significant difference (p -value=0.87).

[Table/Fig-10] illustrates mean CFUs between different time intervals in each study group using Friedman's test followed by Wilcoxon's Signed Rank post-hoc analysis revealed statistically significant reduction from baseline to different time intervals (p -value <0.001).

Groups	Time	N	Mean	SD	Min	Max	p-value ^a	Significant difference	p-value ^b
Group I	BL	15	4540.00	4620.11	100	10000	<0.001*	Baseline vs T1	0.002*
	T1	15	508.00	477.29	10	1000		Baseline vs T2	0.001*
	T2	15	68.00	46.94	0	100		T1 vs T2	0.003*
Group II	BL	15	5140.00	4711.05	100	10000	<0.001*	Baseline vs T1	0.001*
	T1	15	448.00	467.49	10	1000		Baseline vs T2	0.001*
	T2	15	26.00	38.51	0	100		T1 vs T2	0.001*
Group III	BL	15	5740.00	4719.23	100	10000	<0.001*	Baseline vs T1	0.001*
	T1	15	268.00	380.12	10	1000		Baseline vs T2	0.001*
	T2	15	18.67	33.35	0	100		T1 vs T2	0.001*

[Table/Fig-10]: Comparison of mean CFUs between different time intervals in each study group.

Statistical test; ^a: Friedman's test; ^b: Wilcoxon's Signed Rank post-hoc analysis; BL: Baseline; ^c: p -value <0.05 was considered as statistically significant

DISCUSSION

Motivating visually impaired children is a challenging task as it is difficult to establish effective eye level communication with them though instructions through braille pamphlets and audio aids can be used, not all children are given education of the same which is a major limitation in India [8].

As there are various practical difficulties encountered in rendering treatment to such children more emphasis should be made on instilling preventive care at the earliest in such children. As it is well known that primary etiologic factor for initiation of dental caries is poor oral hygiene and dental plaque, routine oral hygiene practice involving mechanical plaque control methods such as brushing needs to be effectively practiced [9]. Proper selection of the brush, brushing techniques should be taught to them in a way they understand better and periodic monitoring should be done of the same [7]. Manual toothbrushes are universally used with

good amount of plaque removal efficacy, if followed the proper technique of brushing [10].

Electric toothbrushes were introduced to overcome the limitations of manual toothbrushes and also to aid in effective plaque removal in those where manual toothbrushing cannot be done effectively [11]. Various studies have compared manual and electric toothbrushes and their plaque removal efficacy [2,3,11-16]. [Table/Fig-11] illustrates findings of similar studies [3,12,13,15,17]. A study was conducted by Kumar P et al., compared manual, electric and customised manual toothbrushes in visually impaired children and concluded that, electronic toothbrushes were superior to customised manual toothbrushes whereas, manual toothbrushes showed least effectiveness [12]. Studies conducted by Sheikh-Al-Eslamian SM et al., and Renton-Harper P et al., compared manual and electric toothbrushes found no significant difference between the two in their efficacy [13,14]. Another study conducted by Vandana KL et al., compared the effectiveness of manual and electric toothbrushes on both oral health and microbial of status in mentally challenged individuals and concluded that, electric toothbrushes were more effective both clinically and microbiologically compared to manual toothbrushes [15].

Electric toothbrushes are automatic and require lesser effort by an individual. They operate by rotating, oscillating or vibrating and exhibit higher degree of plaque removal and are well suited for use in children with special healthcare needs [16]. However, these brushes need assistance to charge and their high cost are a limitation to advise them to use in visually impaired children [3]. Major advantage of nano-b toothbrush is that it is coated with gold and charcoal nanoparticles [18]. These brushes are manual, can be easily used by visually impaired children with least training and are less expensive compared to electric toothbrushes.

A study was conducted by Pavithra D et al., aimed to evaluate microbial contamination and plaque scores of nano-gold coated and uncoated toothbrushes [17]. Results showed that use of a nano-gold coated toothbrush demonstrated significantly lower bristle contamination and lower plaque scores compared with uncoated toothbrushes.

A study was conducted by Lee J et al., to evaluate bacterial contamination of charcoal bristles compared to non-charcoal bristles in used toothbrushes [19]. Results showed that number of CFUs in charcoal toothbrushes was substantially less when compared with non charcoal toothbrushes.

It is of great importance to establish good oral hygiene practices early in life, particularly in special children. Since, children in the present study were in an institutionalised setting, it was easy to teach them brushing technique. Moreover, as teachers were given demonstration of toothbrushing, they were able to provide positive

Author's name and year	Place of study	Number of subjects	Oral hygiene aids used	Parameters assessed	Conclusion
Sheikh-Al-Eslamian SM et al., (2014) [13]	Iran	12	Electric, manual tooth brush	Turesky modified Quigley Hein Plaque index (TQHPI)	Study could not show the superiority of electric toothbrush over manual in plaque removal.
Cui TQ et al., (2017) [3]	Guangzhou	42	Electric, manual toothbrush	Quigley-Hein Plaque Index (Q-H PI) and Loe H and Silness P Gingival Index (GI)	Electric toothbrush reduced plaque and gingivitis more than manual toothbrush.
Kumar P et al., (2018) [12]	Karnataka, India	60	Electric, manual, customised manual toothbrush	Quigley-Hein plaque index (QHI) and Loe-Silness gingival index	Plaque removal efficacy of electronic toothbrush was superior followed by customised manual toothbrush whereas manual toothbrush was least.
Vandana KL et al., (2020) [15]	Karnataka, India	30	Manual, powered toothbrush	Quigley-Hein plaque index, Gingival Bleeding Index (GBI) and modified Gingival Index	Powered toothbrush was more effective than manual toothbrush in reducing plaque levels
Pavithra D et al., (2020) [17]	Karnataka, India	84	Nano-gold coated, uncoated toothbrushes	TQHPI	Nano-gold coated toothbrush demonstrated lower plaque scores than uncoated.
Present study, (2022)	Karnataka, India	45	Manual, electric, nano-b toothbrushes	TQHPI	Nano-b showed greatest plaque reduction followed by electric and manual toothbrush.

[Table/Fig-11]: Findings of similar studies [3,12,13,15,17].

reinforcement to the children everyday about importance and correct method of toothbrushing. Goal of dentist should be to train visually impaired individuals to be independent in oral hygiene care. Self reliance is extremely important for such children and may have a positive impact on the individual's self-esteem [20].

Limitation(s)

Limitations of the study were that, the number of participants selected were less and they were from the same Institution. Time period might have been short, to evaluate the efficacy of different toothbrushes.

CONCLUSION(S)

Clinically and microbiologically, plaque removal efficacy at different time intervals over a period of two months showed greatest reduction in nano-b toothbrush group followed by electric toothbrush group and manual toothbrush group in succession, respectively. However, reduction in mean CFUs between electric and nano-b toothbrush group did not show statistically significant difference. Longer term studies including more patients are required. Goal of Paediatric dentist should be, to conduct frequent oral health programmes to create awareness on importance of oral health and its maintenance in visually impaired children.

REFERENCES

- [1] Alghamdi N, Alshehri M, Abdellatif H. Oral health findings, needs and demands of visually impaired children in Saudi Arabia. *J Dent Health Oral Disord Ther.* 2018;9(3):222-27.
- [2] Aggarwal N, Gupta S, Grover R, Sadana G, Bansal K. Plaque removal efficacy of different toothbrushes: A comparative study. *Int J Clin Pediatr Dent.* 2019;12(5):385-90.
- [3] Cui TQ, Lin HC, Lo E, Tao Y, Zhou Y, Zhi QH. Randomized clinical trial on the efficacy of electric and manual toothbrushes in plaque removal and gingivitis control in visually impaired school students. *Quintessence Int.* 2017;48(6):481-86.
- [4] Mackevica A, Olsson ME, Hansen SF. The release of silver nanoparticles from commercial toothbrushes. *J Hazard Mater.* 2017;322:270-75.
- [5] Davidovich E, Ccahuana-Vasquez RA, Timm H, Grender J, Cunningham P, Zini A, et al. Randomised clinical study of plaque removal efficacy of a power toothbrush in a paediatric population. *Int J Paediatr Dent.* 2017;27(6):558-67.
- [6] Deshmukh J, Vandana KL, Chandrashekar KT, Savitha B. Clinical evaluation of an ionic tooth brush on oral hygiene status, gingival status and microbial parameters. *Indian J Dent Res.* 2006;17:74-77.
- [7] Smutkeeree A, Rojakkawong N, Yimcharoen V. A 6-month comparison of toothbrushing efficacy between the horizontal Scrub and modified Bass methods in visually impaired students. *Int J Paediatr Dent.* 2011;21:278-83.
- [8] Joybell C, Krishnan R. Comparison of two brushing methods-Fone's vs modified bass method in visually impaired children using the audio tactile performance (ATP) technique. *J Clin Diagn Res.* 2015;9(3):ZC19-ZC22.
- [9] Debnath A, Srivastava BK, Shetty P, Eshwar S. New vision for improving the oral health education of visually impaired children-a non randomized control trial. *J Clin Diagn Res.* 2017;11(7):ZC29-ZC32.
- [10] Sharma NC, Qaqish J. A clinical evaluation of the plaque removal efficacy of five manual toothbrushes. *J Clin Dent.* 2010;21:08-12.
- [11] Goyal S, Thomas BS, Bhat KM, Bhat GS. Manual toothbrushing reinforced with audiovisual instruction versus powered toothbrushing among institutionalized mentally challenged subjects-A randomized cross-over clinical trial. *Med Oral Patol Oral Cir Bucal.* 2011;16(3):e359-64.
- [12] Kumar P, Reddy P, Johny J, Varma A, Hunasgi S, Koneru A, et al. Oral hygiene efficacy using manual, customised manual and electronic tooth brush in visually impaired children - A comparative study. *Int J Curr Adv Res.* 2018;7(10):16141-45.
- [13] Sheikh-AI-Eslamian SM, Navid Y, Seyedebrahim SM, Kadkhodazadeh M. Comparison of manual and electric toothbrushing in dental plaque removal: A clinical trial. *Avicenna J Dent Res.* 2014;6(1):05-09.
- [14] Renton-Harper P, Addy M, Newcombe RG. Plaque removal with the un instructed use of electric toothbrushes: Comparison with a manual brush and toothpaste slurry. *J Clin Periodontol.* 2001;28(4):325-30.
- [15] Vandana KL, Tatuskar PV, Valavalkar NN. A comparative evaluation of manual and powered brushing on oral health and microbial status of mentally challenged individuals. *J Indian Soc Periodontol.* 2020;24(4):362-68.
- [16] Aravind A, Peedikayil FC, Chandru TP, Kottayi S. Comparative evaluation of plaque removal efficiency of manual, electric and chewable toothbrush in children: A pilot study. *Int J Med Health Res.* 2018;9(4):51-55.
- [17] Pavithra D, Srirangarajan S, Sri Kumar PK, Ravi J, Vinaya R, Durgesh BH, et al. Microbial contamination and plaque scores of nano-gold coated toothbrush. *Int J Dent Hyg.* 2020;18(3):278-84.
- [18] Ranjeth Rajan KV, Hannah R, Lavanya P. Nano enabled tooth brushes-A review. *PalArch's J. Archaeol. Egypt/ Egyptol.* 2020;17(7):706-17.
- [19] Lee J, Palaniappan K, Hwai T, Kit CW, Dickson DD, Kalyan CG, et al. Comparison of bacterial contamination in bristles of charcoal toothbrushes versus non-charcoal toothbrushes. *Can J Dent Hyg.* 2017;51(2):69-74.
- [20] Nirmala S, Saikrishna D. Oral health and dental care of children with visual impairment-An over view. *EC Dent Sci.* 2019;18(5):848-53.

PARTICULARS OF CONTRIBUTORS:

1. Professor, Department of Paediatric and Preventive Dentistry, Rajarajeswari Dental College and Hospital, Bengaluru, Karnataka, India.
2. Postgraduate Student, Department of Paediatric and Preventive Dentistry, Rajarajeswari Dental College and Hospital, Bengaluru, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. AR Jaya,
House No.-14 Ramohalli Cross, Mysuru Road, Kumbalgodu, Bengaluru,
Karnataka, India.
E-mail: jaya.vrushabh@gmail.com

PLAGIARISM CHECKING METHODS: (Lain H et al.)

- Plagiarism X-checker: May 27, 2022
- Manual Googling: Jun 28, 2022
- iThenticate Software: Sep 10, 2022 (17%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Apr 23, 2022**

Date of Peer Review: **May 28, 2022**

Date of Acceptance: **Aug 11, 2022**

Date of Publishing: **Oct 01, 2022**