

# Comparison of Plaque Removal Efficacy with Powered and Manual Toothbrushes in 10–14-year-old Visually and Auditory Impaired Children: A Randomized Controlled Study

Nikhil G Patel<sup>1</sup>, Seema Bargale<sup>2</sup>, Swara Shah<sup>3</sup>, Akash Ardesana<sup>4</sup>, Pratik B Kariya<sup>5</sup>, Harshangi N Patel<sup>6</sup>

## ABSTRACT

**Aim and objective:** To compare dental plaque removal efficacy with a manual and powered toothbrush in 10–14 years old visually and auditory impaired children.

**Material and methods:** The proposed study was a randomized controlled study. The ethical approval was obtained from the institutional ethical board. The written informed consent for the study was taken from the parents. The 60 participants were categorized into group I: visually impaired (30) and group II: speech and hearing impaired (30) which were again divided into I1 (manual toothbrush) and I2 (powered toothbrush); II1 (manual toothbrush) and II2 (powered toothbrush), respectively. The baseline score was recorded using Turesky–Gilmor–Glickman Modification of The Quigley–Hein plaque Index. The oral prophylaxis was performed and then randomization of the toothbrush group was done with concealed allocation method. The plaque-removal efficacy was evaluated at the end of the 15 days in the visually and hearing-impaired children.

**Results:** The mean score of dental plaque at baseline was 1.44 for the manual toothbrush group and 1.65 for the powered toothbrush group in visually impaired children, respectively. In blind children with a manual toothbrush, the mean score difference was 0.14 while the powered toothbrush showed the mean score difference of 0.30 which is significant. The mean score of dental plaque at baseline was 1.74 for the manual toothbrush group and 1.80 for the powered toothbrush group in auditory impaired children. In auditory impaired children with manual toothbrushes, the mean score difference was 0.15 while the powered toothbrush showed the mean score of 0.32 which was significant.

**Conclusion:** Dental plaque reduction was significantly better with the powered toothbrush as compared to a manual toothbrush in visually and auditory impaired children.

**Keywords:** Manual toothbrush, Plaque index, Powered toothbrush, Sensory impaired children.

*International Journal of Clinical Pediatric Dentistry* (2021): 10.5005/jp-journals-10005-1949

## INTRODUCTION

Children with disabilities are at a higher risk of oral diseases because of a lack of proper oral care by caregivers or parents. Therefore, these children should be taught to maintain oral hygiene despite their disabilities to prevent oral diseases such as caries and periodontal diseases which have specific etiologies of plaque as a contributing factor.<sup>1</sup>

Visually impaired children are generally unable to maintain adequate good oral hygiene levels with manual toothbrushing as they have limited skills and capacity resulting in inadequate plaque or bacterial biofilm removal with a conventional or manual toothbrush. Thus, the use of a powered toothbrush helps to improve the effectiveness of plaque removal in people with visual disabilities.<sup>2</sup>

Whereas in the case of hearing-impaired children, where they can neither hear well even with a hearing aid nor understand speech without specific sign instructions such child also faces problem in plaque control. A pediatric dentist who is going to treat an auditory impaired child should involve parents, guardians, or caregivers during the examination as they help the dentist communicate through sign language.<sup>3</sup>

In visually and hearing-impaired children, mechanical measures such as toothbrushing are not effective to achieve adequate good oral hygiene. Various modified toothbrushes have been advised to increase the mechanical removal of dental plaque. Proper toothbrushing relies on a technically correct toothbrush, inpatient compliance, and manual dexterity of any individual. The ability to

<sup>1</sup>Department of Pedodontics and Preventive Dentistry, Karnavati School of Dentistry, Gandhinagar, Gujarat, India

<sup>2,3,5</sup>Department of Pedodontics and Preventive Dentistry, KM Shah Dental College and Hospital, Sumandeep Vidyapeeth, Vadodara, Gujarat, India

<sup>4</sup>Little Star Kids Dental Care, Shree Children Hospital, Rajkot, Gujarat, India

<sup>6</sup>Goradwala Dental Hospital, Mehsana, Gujarat, India

**Corresponding Author:** Seema Bargale, Department of Pedodontics and Preventive Dentistry, KM Shah Dental College and Hospital, Sumandeep Vidyapeeth, Vadodara, Gujarat, India, Phone: +91 7016048359, e-mail: drseemabargale@gmail.com

**How to cite this article:** Patel NG, Bargale S, Shah S, *et al.* Comparison of Plaque Removal Efficacy with Powered and Manual Toothbrushes in 10–14-year-old Visually and Auditory Impaired Children: A Randomized Controlled Study. *Int J Clin Pediatr Dent* 2021;14(3): 364–368.

**Source of support:** Nil

**Conflict of interest:** None

use the toothbrush by a child with a disability as well as a normal individual depends on age, individual dexterity, and motivation by parents or caregivers.<sup>2</sup>

Yousaf *et al.* have shown increase efficacy of plaque removal and decrease in gingivitis with oscillating and rotating designed powered toothbrushes.<sup>4</sup> The powered toothbrushes can also be

used for visually and hearing-impaired children to remove plaque and reduce dental diseases.

To the best of our knowledge, there are no studies in the scientific literature on the comparison of plaque removal efficacy using a manual and powered toothbrush in sensory impaired children. This study was conducted to compare the effectiveness of plaque removal ability using a manual and powered toothbrush in visually and auditory impaired children.

## MATERIALS AND METHODS

The study was designed as a randomized controlled study on visually and auditory impaired children with a written permission letter from the Government School for the Blind (visually impaired child) and Smt. Kamalaben Badhir Vidhyalay (speech and hearing impairment child). The institutional ethical approval was taken from the Ethics committee of (SVIEC/ON/DENT/BNPG-14/D15045) as per the Helsinki declaration. The sample size determination was 30 participants for each visually and hearing-impaired children group with further mentioned inclusion criteria. The inclusion criteria were 10–14-year-old children with a visual and auditory impairment who had the brushing ability, did not use any supplemental plaque control aids, and whose parents and caretakers gave consent for the study. Exclusion criteria included, visually and auditory impaired children who were on medications for any systemic conditions.

A thorough oral examination is conducted by the principal investigator for all the participants. The baseline score was recorded using the plaque disclosing solution and Turesky–Gilmor–Glickman Modification of The Quigley–Hein plaque Index.<sup>5</sup> The oral prophylaxis was carried out before the randomization of the group. The participants were distributed into four groups as per the concealed randomization sheet. The training sessions for the

caregiver/teacher were conducted for toothbrushing methods including video presentation followed by a hands-on session.

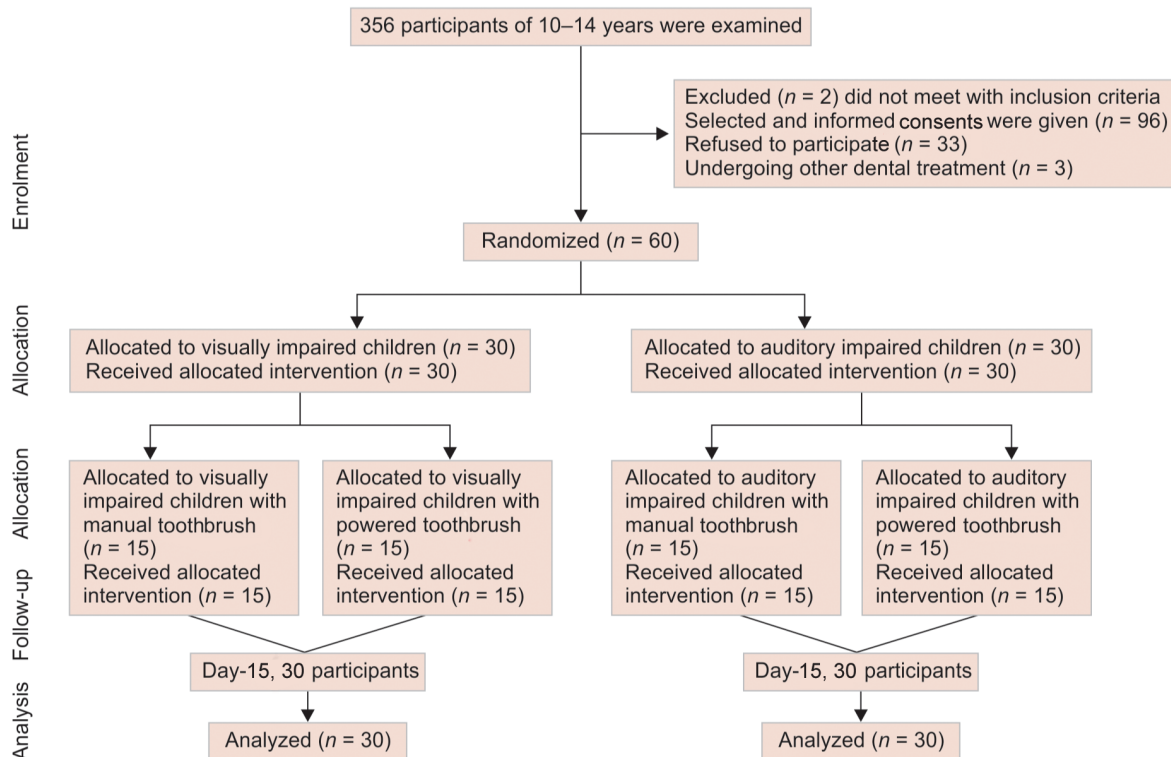
The label for each toothbrush group as I visually (I1 and I2) and I hearing (II1 and II2) impaired children was done by a person other than the principal investigator. The list of blinded groups was sealed in an envelope which was opened only after completion of the study. Based on the grouping, the person who had labeled the groups was instructed to dispense the toothbrush accordingly. A total of 60 participants were divided into two groups. Thirty visually (group I) and auditory (group II) impaired children were further divided into 15 each as I1 (manual toothbrush), I2 (powered toothbrush), II1 (manual toothbrush), and II2 (powered toothbrush), respectively (Flowchart 1).

For the manual toothbrush group, the proper brushing technique was taught to all participants and caretakers. The powered toothbrush group also received demonstrations for participants and caretakers on how to use the powered toothbrush. The caretakers and teachers were instructed to monitor and report whether the children brush their teeth for 2 minutes using the same amount of toothpaste twice per day. The plaque-removal efficacy was evaluated at the end of the 15 days, in the morning immediately after toothbrushing using Turesky–Gilmor–Glickman Modification of The Quigley–Hein plaque Index. The collected data were analyzed using SYSTAT version 13. Independent *t*-test and paired *t*-test were used to compare the intragroup comparison, respectively.

## RESULTS

A self-designed format was used to record personal details which were containing child name, age, gender, reasons for visual and auditory impairment with their oral hygiene methods. The 30

Flowchart 1: The CONSORT diagram shows the flowchart of participants



participants were divided into visually (group I) and auditory (group II) impaired children, respectively.

Table 1 shows the mean plaque score at baseline 1.44 for manual toothbrushes and 1.65 for powered toothbrushes with respect to visually impaired children. There was no statistically significant difference in baseline scores between manual and powered toothbrushes. Post toothbrushing mean plaque score was 1.30 for manual toothbrushes and 1.35 for powered toothbrushes with respect to visually impaired children. There is no statistically significant difference in post toothbrushing mean plaque score between manual and powered toothbrushes. The mean plaque score difference for manual toothbrushes was 0.15 and powered toothbrushes was 0.3 with respect to visually impaired children. There was a statistically significant difference between manual and powered toothbrushes where the mean score difference was highly significant in powered toothbrushes with ( $p$  value is  $<0.001$ ).

Table 2 shows the mean plaque score at baseline 1.74 for manual toothbrushes and 1.80 for powered toothbrushes with respect to auditory impaired children with no statistically significant difference, where the mean score was significantly high in powered toothbrushes ( $p$  value = 0.659). Post toothbrushing plaque score was 1.59 for manual toothbrushes and 1.46 for powered toothbrushes with respect to auditory impaired children with no statistically significant difference, where the mean score was significantly high in powered toothbrushes ( $p$  value = 0.204). The mean plaque score difference for the manual was 0.15 and for a powered toothbrush was 0.32 with respect to auditory impaired children. There is a statistically significant difference between manual and powered toothbrushes with respect to auditory impaired children where the mean score difference was significantly high in powered toothbrushes ( $p$  value  $< 0.001$ ).

## DISCUSSION

Oral health is a live part of overall systemic health. It is said that it contributes to quality life by positively affecting physical and mental well-being to each individual by appearance and interpersonal relations.<sup>6</sup> Most sensory impaired children start their lives with

healthy, strong gums, and teeth as those of normal people. But due to their diet, eating pattern, medication, physical limitations, lack of cleaning habits, and attitudes of parents or caregivers and healthcare providers, all are directly or indirectly affecting oral health.<sup>7</sup> The inability to maintain proper good oral hygiene is a key factor that influences the prevalence of dental disease in handicapped children.

Sensory impairment is when one of the individual's senses like sight, hearing, smell, touch, taste, and spatial awareness, is no longer normal. This can be the combination of both hearing and sight impairment. Visual impairment relates to a person's eyesight which affects the normal vision of an individual. There are two types of visual disability, namely low vision that is partially blind and absolutely nil vision that is totally blind.<sup>8</sup> A study by Chang and Shih evaluated that visually impaired children had less knowledge about their oral care and its measures.<sup>9</sup>

Children with a hearing impairment can neither hear well even with a hearing aid nor understand speech without specific instructions. Such children have difficulty living a current normal life and demand a healthy life.<sup>10</sup> It is noticeable that usually disabled individuals have difficulty maintaining good oral hygiene especially those with hearing impairment who cannot understand and respond to the instructions given and those who are visually impaired lack the vision to understand and master the technique of oral hygiene practices.<sup>7</sup>

The bacterial biofilm or plaque leads to various periodontal conditions and diseases. To prevent these conditions, effective methods like mechanical and chemical control of plaque helps to maintain good oral health and improve gingival and periodontal health. Despite toothbrushing being the most accepted method of plaque removal, its efficacy depends on the type of brush, the method used, and timing of brushing last but not least the individual dexterity of toothbrushing.<sup>11</sup>

Manual toothbrushing needs a certain degree of individual manual dexterity. Several studies showed that disabled children are unable to achieve a sufficient oral hygiene level manually due to their compromised motor skills and lack of knowledge.<sup>12,13</sup>

**Table 1:** Intergroup comparison of baseline and post-toothbrushing plaque score of visually impaired children in relation to a manual and powered toothbrush

Score	Toothbrush type (N = 15)	Mean	Std. deviation	Std. error mean	p value
Baseline	Manual toothbrush	1.44	0.37	0.09	0.213
	Powered toothbrush	1.65	0.52	0.13	
Brushing after 15 days	Manual toothbrush	1.30	0.32	0.08	0.682
	Powered toothbrush	1.35	0.43	0.11	
Difference	Manual toothbrush	0.14	0.06	0.01	$<0.001$
	Powered toothbrush	0.30	0.11	0.02	

**Table 2:** Intergroup comparison of baseline and post-toothbrushing plaque score of auditory impaired children in relation to a manual and powered toothbrush

Score	Toothbrush type (N = 15)	Mean	Std. deviation	Std. error mean	p value
Baseline	Manual toothbrush	1.74	0.18	0.046	0.659
	Powered toothbrush	1.80	0.42	0.108	
Brushing after 15 days	Manual toothbrush	1.59	0.15	0.040	0.204
	Powered toothbrush	1.46	0.33	0.086	
Difference	Manual toothbrush	0.15	0.03	0.009	$<0.001$
	Powered toothbrush	0.34	0.09	0.023	

Further, they cannot able to maintain good oral hygiene due to a lack of effective toothbrushing, less amount of time spent on brushing than recommended, or a combination of these. Hence, ionic or powered toothbrushes have been investigated to facilitate tooth cleaning of special individuals and help to improve the oral health.<sup>11</sup>

Powered toothbrushes were introduced in the 1960s, which can be considered as an alternative to manual toothbrushes. It is beneficial in a child with a disability as well as in dexterity patients.<sup>14,15</sup> Grossman and Proskin<sup>16</sup> observed that an electric toothbrush was more effective in removing plaque than a manual toothbrush in healthy children also. Two main toothbrushes, a manual and powered toothbrush as mechanical plaque control agent has been used in the present study.

The powered toothbrush removed plaque effectively than the manual toothbrush over the 15 days which results comparable to studies done by Breuer et al.,<sup>17</sup> Mayer,<sup>18</sup> and Niederman.<sup>19</sup> This clinically significant result may be obtained due to the acoustic microstreaming property of the toothbrush, which breaks the attachment apparatus of biofilm-containing microorganisms that form plaque.<sup>20</sup> Based on the above, this study was conducted for the 15 days plaque removal efficacy in visually and auditory impaired children.

The institutionalized randomized control trial done by Kaur et al.<sup>21</sup> revealed that there is a significant difference in the oral hygiene levels of the mentally and physically challenged. They found a decrease in mean OHI-S of physically challenged children was 2.58 and mentally challenged children were 4.95 with proper oral hygiene maintenance. The present institutionalized study was done on visually impaired children and auditory impaired children where the baseline and post toothbrushing plaque scores were recorded with the use of a manual and powered toothbrush.

Hebbal and Ankola<sup>22</sup> have been noted that the absence of visual stimuli limits rapid learning which represents a challenge for dentists for motivating these individuals to have appropriate oral hygiene care. The visually impaired and auditory impaired children with powered toothbrushes shown plaque score reduction almost twice when compared with visually and auditory impaired children with the manual toothbrush group, respectively.

Maciel et al. reported the efficiency of education and motivation to improve oral hygiene in visually impaired patients.<sup>23</sup> They reported marked reduction in plaque occur, mainly due to the assimilation of techniques appropriate to achieving oral hygiene and therefore the acquisition of healthy habits and routines. The present study had shown the mean score reduction of dental plaque in the visually impaired children in manual 0.14 as well as powered toothbrush group 0.30 after 15 days interval ( $p$  value < 0.001).

Sandeep et al.<sup>24</sup> have seen a significant reduction of plaque and gingival scores in the hearing impaired children group compared with the control group indicating a positive impact of visual motivation. The present study showed a significant mean score reduction of dental plaque in the hearing-impaired children in manual 0.15 as well as powered toothbrush group 0.32 after the video presentation ( $p$  value < 0.001).

The few limitations of the study are that study can be done with long-term follow-up with a larger sample size to know the better plaque removal efficacy in sensory impaired children. The cross-over study design should be done to evaluate the plaque removal efficacy with a manual and powered toothbrush in sensory-impaired children.

## CONCLUSION

This randomized controlled study depicts the manual and powered toothbrushes significantly reduce plaque accumulation. The inference of this study supports the argument that a powered toothbrush has high potential when compared with a manual toothbrush to achieving plaque reduction in visually and auditory impaired children. Powered toothbrushes provide the ability to all sensory impaired individual to brush the teeth which optimally remove plaque and improve the health of gingiva. In the present study among all groups, the auditory impairment group with powered toothbrushes showed more reduction of plaque because auditory impaired children can see and understand visually when compared with the visually impaired children group.

## REFERENCES

- Jain A, Gupta J, Aggarwal V, et al. To evaluate the comparative status of oral health practices, oral hygiene and periodontal status amongst visually impaired and sighted students. *Spec Care Dentist* 2013;33(2):78–84. DOI: 10.1111/j.1754-4505.2012.00296.x.
- Sharma A, Arora R, Kenchappa M, et al. Clinical evaluation of the plaque removing ability of four different toothbrushes in visually impaired children. *Oral Health Prev Dent* 2012;10(3):219–224.
- Djeri A, Radman IK, Grabež M, et al. Oral health in children with hearing and speech impairment in Banjaluca. *Serbin Dent J* 2013;60(3):139–146. DOI: 10.2298/SGS1303139D.
- Yousaf A, Aman D, Manzoor A, et al. Compression of powered and manual tooth brush in removal of plaque. *Pak Oral Dental J* 2012;32(1):120–123.
- Dulgergil T, Civelek A, Soyman M, et al. Dental plaque removal efficacy of a battery powered and manual toothbrush. *Oral Health Dent Manag* 2004;3(1):7–11.
- Rao D, Hegde A, Munshi AK. Oral hygiene status of disabled children and adolescents attending special schools of South Canara, India. *Hong Kong Dent J* 2005;2:107–113.
- Kamatchy KR, Joseph J, Krishnan CG. Dental caries prevalence and experience among the group of institutionalized hearing-impaired individuals in Pondicherry - a descriptive study. *Indian J Dent Res* 2003;14(1):29–32.
- Zainal M, Ismail SM, Ropilah AR, et al. Prevalence of blindness and low vision in Malaysian population: results from the national eye survey. *Br J Ophthalmol* 2002;86(9):951–956. DOI: 10.1136/bjo.86.9.951.
- Chang CS, Shih Y. Knowledge of dental health and oral hygiene practices of Taiwanese visually impaired and sighted students. *J Visual Impairment Blindness* 2004;98(5):1–27. DOI: 10.1177/0145482X0409800504.
- Thompson DC, McPhillips H, Davis RL. Universal newborn hearing screening: summary of evidence. *J Am Dent Assoc* 2001;286(16):2000–2010. DOI: 10.1001/jama.286.16.2000.
- García-Godoy F. The safety and efficacy of a children's power toothbrush and a manual toothbrush in 6 to 11 year olds. *Am J Dent* 2001;14(4):195–199. DOI: 10.1016/S0002-8223(01)00052-9.
- Kallar S, Pandit IK, Srivastava N, et al. Plaque removal efficacy of powered and manual toothbrushes under supervised and unsupervised conditions: a comparative clinical study. *J Indian Soc Pedod Prev Dent* 2011;29(3):235–238. DOI: 10.4103/0970-4388.85832.
- Ghassemi A, Vorwerk L, Hooper W, et al. Comparative plaque removal efficacy of a new children's powered toothbrush and a manual toothbrush. *J Clin Dent* 2013;24(1):1–4.
- Hoover JN, Singer D. Toothbrushes: manual and electric. *J Can Dent Assoc* 1994;60(10):880–884.
- Ashley P. Toothbrushing: why, when and how? *Dent Update* 2001;28(1):36–40. DOI: 10.12968/denu.2001.28.1.36.
- Grossman E, Proskin H. A comparison of the efficacy and safety of an electric and a manual children's toothbrush. *J Am Dent Assoc* 1997;128(4):469–474. DOI: 10.14219/jada.archive.1997.0232.

17. Breuer MM, Cosgrove R, Hardy D, et al. A comparison of the plaque-removal efficacies of two electric toothbrushes. *Quintessence Int* 1989;20(7):501–504.
18. Mayer R. Electric toothbrush manual toothbrush, a comparison test. *ZWR* 1990;99(3):188–192.
19. Niederman R. ADA Council on Scientific Affairs; ADA Division of Science; Journal of the American Dental Association Manual versus powered toothbrushes: the Cochrane review. *J Am Dent Assoc* 2003;134(9):1240–1244. DOI: 10.14219/jada.archive.2003.0359.
20. McInnes C, Engel D, Martin RW. Fimbria damage and removal of adherent bacteria after exposure to acoustic energy. *Oral Microbiol Immunol* 1993;8(5):277–282. DOI: 10.1111/j.1399-302x.1993.tb00574.x.
21. Kaur S, Malhotra R, Malhotra R, et al. Oral hygiene status of mentally and physically challenged individuals living in a specialized institution in Mohali, India. *Indian J Oral Sci* 2013;4(1):17–22. DOI: 10.4103/0976-6944.118515.
22. Hebbal M, Ankola A V. Development of a new technique (ATP) for training visually impaired children in oral hygiene maintenance. *Eur J Paediatr Dent* 2012;5(5):242–247. DOI: 10.1007/BF03262878.
23. Maciel MAS, Cordeiro PM, d'Ávila S. Assessing the oral condition of visually impaired individuals attending the Paraíba Institute of the Blind. *Revista Odonto Ciencia* 2009;24:354–360.
24. Sandeep V, Vinay C, Madhuri V, et al. Impact of visual instruction on oral hygiene status of children with hearing impairment. *J Indian Soc Pedod Prev Dent* 2014;32(1):39–43. DOI: 10.4103/0970-4388.127053.