Efficacy of a Modified Audio-Tactile Performance Technique with Braille (ATPb) on the Oral Hygiene Status of Visually-Impaired Children

Devika J Nair */ Amarshree A Shetty **/Amitha M Hegde***

Objective: *We assessed the effectiveness of a modified audio-tactile performance (ATP) technique with braille (ATPb) on the oral health statuses of visually-impaired children.* ***Study design:*** *Ninety visually-impaired institutionalized children received oral hygiene instructions using audio (AM), ATP or ATPb techniques. Plaque scores were assessed at baseline and after reinforcement and non-reinforcement periods.* ***Results:*** *In the totally visually-impaired, mean reductions in plaque scores in the ATPb, ATP and AM groups during the reinforcement period were 1.119 ± 0.260, 0.654 ± 0.239 and 0.237 ± 0.255, respectively ($p < 0.001$), worsening to 0.107 ± 0.160, 0.083 ± 0.193 and -0.208 ± 0.267 during the non-reinforcement period ($p < 0.001$), before culminating at 6 months at 1.227 ± 0.261, 0.737 ± 0.317 and 0.029 ± 0.108 ($p < 0.001$). In partially visually-impaired children, reductions during the reinforcement period were 0.934 ± 0.279, 0.762 ± 0.270 and 0.118 ± 0.237, respectively, dropping to 0.176 ± 0.166, 0.083 ± 0.169 and -0.128 ± 0.114 without reinforcement and culminating at 1.109 ± 0.258, 0.845 ± 0.292 and -0.010 ± 0.226 ($p < 0.001$). There were significant inter-group differences during the three periods ($p < 0.001$), except in the ATP and ATPb groups during the non-reinforcement period for totally impaired ($p = 0.157$) and during reinforcement ($p = 0.155$) and non-reinforcement ($p = 0.051$) periods for partially impaired children.* ***Conclusions****: All three techniques were successful when reinforced periodically. However, only ATP and ATPb were successful during periods without reinforcement. The modified audio-tactile performance technique with braille (ATPb) was most effective, allowing visually-impaired children to retain oral hygiene information without intervention.*

Keywords: *Audio-tactile technique, Braille, Oral health education, Visually impaired children.*

INTRODUCTION

People with disabilities constitute a large percentage of the population and the number of individuals with disabilities is increasing due to significant medical developments in recent years which have enhanced survival.[1] During the early years of life, a child learns to understand and construe their environment with the help of their primary senses, of which vision is the most important. Thus, when sight is impaired or absent in childhood, it can have detrimental effects on their physical, neurological, cognitive and emotional development.

In 2012, the World Health Organization (WHO) estimated that approximately 285 million people were visually impaired, of which 39 million were blind and 246 million had low vision.[2] In India, about 280,000–320,000 children are visually-impaired.[3] As visually-impaired individuals may be able to differentiate images, light and colours or even read large print, the term does not necessarily indicate a complete lack of sight.[4] Nevertheless, the visually-impaired tend to depend on their other senses to adapt themselves to their surroundings, such as sound, speech, and touch.[5]

From A.B. Shetty Memorial Institute of Dental Sciences, Mangaluru, India.
*Devika J. Nair, BDS,MDS, Postgraduate Resident.
** Amarshree A. Shetty, BDS,MDS, PhD , Professor.
***Amitha M. Hegde, BDS,MDS,PhD, Senior Professor and Head of Department.

Corresponding Author:
Devika J Nair,
Department of Pedodontics and Preventive Dentistry
A.B. Shetty Memorial Institute of Dental Sciences
NITTE University, Deralakatte
Mangaluru 575018
Phone: (0091) 9538417252
E-mail: devikajk@hotmail.com

Oral health is fundamental to the overall health of an individual. However, visually-impaired children often have poorer oral hygiene compared to their sighted counterparts and usually experience difficulty in maintaining their oral health as they cannot detect and recognise early signs of dental disease.[4,6,7] The absence of visual-motor coordination, insufficient parental supervision and the child's lack of concern for their appearance are other contributory factors.[8] Visually-impaired children deserve the same opportunities for treatment as those who are otherwise healthy. Unfortunately, factors associated with unmet dental care needs among children with special healthcare needs include living in low-income households or rural areas, a failure to receive adequate medical care, increased special needs severity and lower degree of functioning, poor psychological adjustment and caregiver-related factors such as depression and low levels of functioning.[9]

Oral health education is key in the prevention of oral diseases. However, conventional methods of health education may not be effective to motivate visually-impaired children.[10] Various studies have investigated the use of verbal and tactile aids, braille and music-based education programs to educate and train such children on oral hygiene maintenance. Verbal health talks are the most convenient means of delivering such oral health education.

Braille is a tactile writing system introduced by Louis Braille and is traditionally written on embossed paper. It consists of small rectangular blocks called cells that contain tiny raised dots corresponding to letters of the alphabet. Audio-tactile performance (ATP) is an oral health education technique for the blind that was introduced by Hebbal *et al* in 2011. In this method, children are taught techniques for brushing their teeth using both audio and tactile aids.[11] The aim of the current study was to modify the ATP technique by incorporating braille and to compare its effectiveness with conventional audio methods (AM) and ATP techniques.

MATERIAL AND METHOD

Ninety institutionalized children between 6–15 years old with either total or partial visual impairment were selected from three schools in two adjoining southern states in India. Ethical clearance from our institution's ethics board and permission from the school authorities was obtained prior to the study. As these children were institutionalised, informed consent for their inclusion in the study was obtained from their parents by the school authorities. The ability to read braille was deemed an essential criterion for inclusion. Subjects were excluded from the study if they had any underlying systemic illnesses or other handicapping conditions, were on any long-term medications or had rampant caries. They were also not included if the child was uncooperative or if they had attended camps or received oral health education in the preceding six months prior to the study.

A randomly selection of 30 children from each school were allocated to one of three groups, with each group receiving a different form of dental health education. The first group received AM, the second received ATP and the third received a modified ATP technique with braille (ATPb). The study comprised four phases, consisting of interaction and collection of baseline data (phase I), oral health education (phase II), a reinforcement period (phase III) and a non-reinforcement period (phase IV). The efficacy of the education techniques was assessed separately among children with total and partial impairment.

Phase I: Interaction and Collection of Baseline Data

An interactive session was carried out with the visually-impaired children to build a good rapport and to assess their level of cooperation. These sessions also aimed to assess the children's baseline knowledge and attitudes towards maintaining adequate oral hygiene and their capacity for self-maintenance. As this was their first time interacting with the dentist for most children, a relaxed and friendly environment was maintained.

The personal details (name, age and gender), degree of visual impairment (total or partial) and existing oral hygiene maintenance habits (material, frequency and method of tooth brushing) of each child were recorded in a specially-designed data sheet. All questions were asked individually to each child and confidentiality was maintained. Subsequently, a clinical examination was performed within school premises in natural daylight with a sterile mouth mirror and an explorer while the child sat on a simple chair. Mouth masks and gloves were not utilized as the children were noted to be generally apprehensive towards these accoutrements during the preliminary sessions. In order to ensure familiarity and cooperation, each instrument and its function was explained to the child and they were allowed to handle the instruments prior to the start of the examination. Baseline plaque scores were subsequently recorded using the simplified Silness-Löe Plaque Index. [12]

Phase II: Oral Health Education

Three different techniques for oral health education were utilized for children in each school.

Group I: Audio Method (AM)

Thirty children from a school in Kerala State were included in the first group and received oral health education and instructions on brushing techniques via audio means alone. A health talk was delivered explaining the importance of teeth and the need to maintain adequate oral hygiene. Various methods of oral hygiene maintenance such as brushing and flossing of the teeth were explained to the children. The modified Bass technique was described and the children were made to repeat it verbally until they were deemed to have comprehended the method well.

Group II: Audio-Tactile Performance (ATP) Technique

Thirty children from another school in the same state were included in the second group and received oral health education via a conventional ATP technique. The children were first verbally taught the importance of oral hygiene and brushing techniques, before later being made to feel large models of a tooth set using their fingers. Brushing techniques were demonstrated using these models. A zinc oxide eugenol cement was used to simulate calculi in the cervical areas of the posterior teeth and the lingual areas of the anterior teeth. This was done with the intention of helping the children identify such areas in their own mouths. The modified Bass technique was taught by guiding the child's hands over the models and performing the necessary strokes with accompanying verbal explanations. The children were then requested to try the technique themselves. They then repeated the brushing technique several times without a time frame until they had mastered it.

Group III: Modified Audio-Tactile Performance Technique with Braille (ATPb)

Thirty children from a school in the adjoining state of Karnataka were included in the third group and received oral health education using a modified ATP technique which incorporated instructions in braille. The conventional ATP technique as taught in Group II was followed; however, the children also received a braille pamphlet detailing a custom-designed story explaining the need for oral hygiene maintenance along with instructions for the modified Bass brushing technique. The story starts with an entry into "Tooth city" where they meet familiar cartoon characters. They then take them around showing the plaque accumulations, cavities, gingival status and explain in common terms about oral hygiene. The conversation between these characters dwells further into the bad and good tooth brushing techniques. The story was first explained to the children verbally and was then read aloud, from braille pamphlet, first by each child individually and then later in a group setting. The children were also instructed to read the pamphlet at least once a week during class.

Phase III: Reinforcement Period

Following the initial education sessions, the children underwent a three-month reinforcement period, during which monthly visits were made to each school and the brushing technique was reinforced using the respective oral health education methods described above. This was done with the intention of further acquainting the children with the brushing technique so that they could put it into practice in daily life. The teachers were also educated and trained during this time, so that they could supervise the children during the brushing process. Plaque scores using the simplified Silness-Löe Plaque Index were re-assessed at the end of this period.

Phase IV: Non-Reinforcement Period

The children then underwent a non-reinforcement period over the final three months of the study period. During this time, no oral health education was given. This period was intended to assess which of the three oral health education methods was most effective for good oral hygiene maintenance and was most likely to be retained without intervention. Plaque scores using the simplified Silness-Löe Plaque Index were once again re-assessed after three months of non-reinforcement.

Statistical Analysis

Collected data were summarised using descriptive statistics such as frequencies, percentages, means and standard deviations. In order to compare outcome measures between the totally and partially visually-impaired children, an independent sample t-test was used. In addition, pairwise comparisons of consecutive measurements within groups were analysed using a paired t-test. Kruskal-Wallis and Man-Whitney U tests were performed for data which did not follow a normal distribution. Data management and analysis was performed using Microsoft Excel and SPSS Version 20.0 (IBM Inc., Chicago, IL, USA).

RESULTS

A total of ninety visually-impaired children received oral hygiene instructions using three different oral health education techniques. Each group included 30 children from one of three schools. The mean age was 10.23 ± 2.41 years and there were 48% males and 52% females. Overall, 40 children (44.4%) had total visual impairment, while 50 (55.6%) had partial visual impairment. Thirteen (43.3%) of the children in Group I receiving AM oral health education, 13 (43.3%) in Group II receiving ATP oral health education and 14 (46.7%) in Group III receiving modified ATPb oral health education had total blindness (Table 1).

The oral hygiene status of the children was poor, with a mean baseline plaque score of 2.031 ± 0.411. Although the mean plaque scores of the totally visually-impaired children (2.104 ± 0.390) was greater than that of the partially visually-impaired children (1.972 ± 0.422), this difference was not statistically significant ($p = 0.13$). The demographic characteristics and baseline plaque scores of the different groups are shown in Table 1. In Groups I and III, the partially visually-impaired children had better oral hygiene statuses; in contrast, in Group II, the totally visually-impaired fared better. However, there were no statistically significant differences in mean plaque scores based on degree of blindness within any of the three groups (Figure 1).

The effectiveness of each oral health education technique was compared separately among the totally and partially visually-impaired children to assess the most effective means of delivering oral hygiene instructions to such children.

Children with Total Visual Impairment

Among the totally visually-impaired children, the maximum reduction in plaque scores during the reinforcement period was seen in Group III receiving ATPb education, with a mean difference of 1.119 ± 0.260, followed by Groups II and I receiving ATP and AM education, with mean differences of 0.654 ± 0.239 and 0.237 ± 0.255, respectively (Fig. 2). There were significant differences in effectiveness during this period within each group ($p < 0.001$) (Table 2). When effectiveness between groups was compared, we found significant differences between Groups I and II, Groups I and III and Groups II and III ($p < 0.001$) (Table 3).

During the three-month period where there were no attempts at reinforcement, the maximum reduction in scores was seen in Group III, followed by Group II, with mean differences of 0.107 ± 0.160 and 0.083 ± 0.193, respectively. However, in Group I, scores worsened over time, with a mean difference of -0.208 ± 0.267 (Figure 2). There was significant difference in effectiveness within groups during this period ($p < 0.001$) (Table 2). In terms of effectiveness between individual groups, significant differences were noted only between Groups I and II and Groups I and III ($p < 0.001$), with no difference in effectiveness between Groups II and III ($p = 0.157$) (Table 3).

At the end of the six-month study period (i.e. after both periods of reinforcement and non-reinforcement), the maximum reduction in scores was seen in Group III, followed by Groups II and I. Mean differences during this time were 1.227 ± 0.261, 0.737 ± 0.317 and 0.029 ± 0.108, respectively (Figure 2). There were significant differences in effectiveness within the groups ($p < 0.001$) (Table 2). We also noted significant differences in effectiveness between Groups I and II, Groups I and III and Groups II and III (Table 3).

Table 1. Table showing the demographics and characteristics of the study group

Number of children			30	30	30
Blindness		Total n (%)	13 (43.3)	13 (43.3)	14 (46.7)
		Partial n (%)	17 (56.7)	17 (56.7)	16 (53.3)
Gender	Male n (%)	Total	7 (53.8)	3 (23.1)	10 (71.45)
		Partial	6 (35.3)	8 (47.1)	9 (56.3)
	Female n (%)	Total	6 (46.2)	10 (76.9)	4 (28.6)
		Partial	11 (64.7)	9 (52.9)	7(43.7)
Age		Total Mean ± SD	9.69±2.63	12.08±2.50	9.57±2.31
		Partial Mean ± SD	10.53±2.21	9.47±2.10	10.25±2.27
Plaque score		Total Mean ± SD	1.839±0.226	2.092±0.272	2.362±0.195
		Partial Mean ± SD	1.541±0.348	2.120±0.259	2.260±0.225
			Group I AM	Group II ATP	Group III ATPb

Table 2. Table showing the effectiveness of the three techniques on the oral hygiene status of the totally and partially visually impaired children during the study period.

Blindness	Groups	Baseline–Reinforced 0-3 months		Reinforced – Non-reinforced 3-6 months		Baseline- Non- reinforced 0-6 months	
		Mean difference	p value	Mean difference	p value	Mean difference	p value
Total	Group I (AM)	0.237±0.255	<0.001	-0.208±0.267	<0.001	0.029±0.108	<0.001
	Group II (ATP)	0.654±0.239		0.083±0.193		0.737±0.317	
	Group III (ATPb)	1.119±0.260		0.107±0.160		1.227±0.261	
Partial	Group I (AM)	0.118±0.237	<0.001	-0.128±0.114	<0.001	-0.010±0.226	<0.001
	Group II (ATP)	0.762±0.270		0.083±0.169		0.845±0.292	
	Group III (ATPb)	0.934±0.279		0.176±0.166		1.109±0.258	

Table 3: Table showing the group wise comparison of effectiveness of the three techniques based on the degree of blindness

Blindness	Groups	Baseline–Reinforced 0-3 months		Reinforced – Non-reinforced 3-6 months		Baseline- Non- reinforced 0-6 months	
		Mean difference	p value	Mean difference	p value	Mean difference	p value
Total	Group I and II (AM and ATP)	0.417	<0.001	0.291	0.000	0.708	<0.001
	Group I and III (AM and ATPb)	0.882	<0.001	0.315	0.001	1.198	<0.001
	Group II and III (ATP and ATPb)	0.466	<0.001	0.023	0.157	0.489	<0.001
Partial	Group I and II (AM and ATP)	0.644	<0.001	0.21	<0.001	0.855	<0.001
	Group I and III (AM and ATPb)	0.816	<0.001	0.303	<0.001	1.119	<0.001
	Group II and III (ATP and ATPb)	0.172	0.155	0.092	0.051	0.264	0.015

Figure 1. Comparison of the mean baseline plaque scores of the totally and partially visually impaired children within the groups.

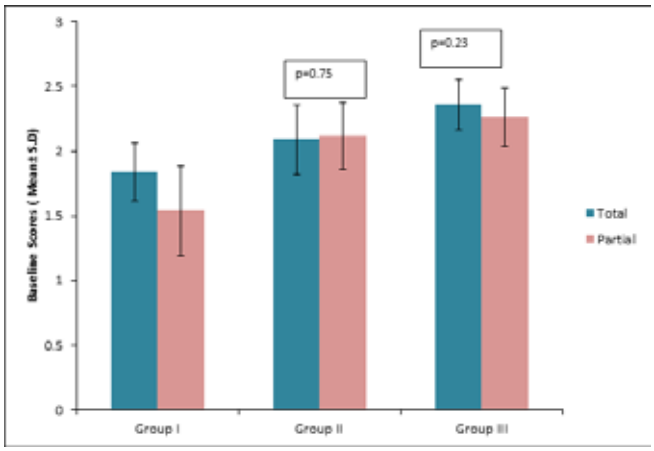


Figure 2. Comparison of the effectiveness of the three oral health education techniques on the oral health status of totally visually impaired children.

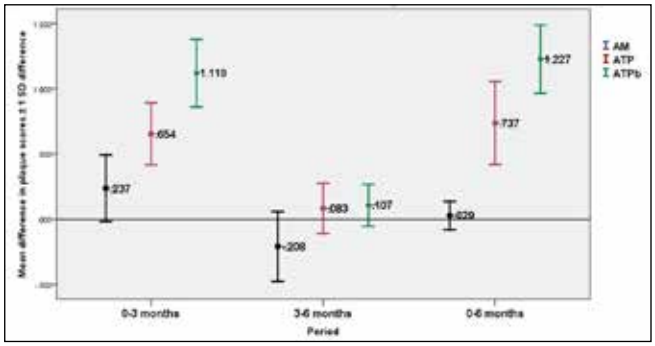
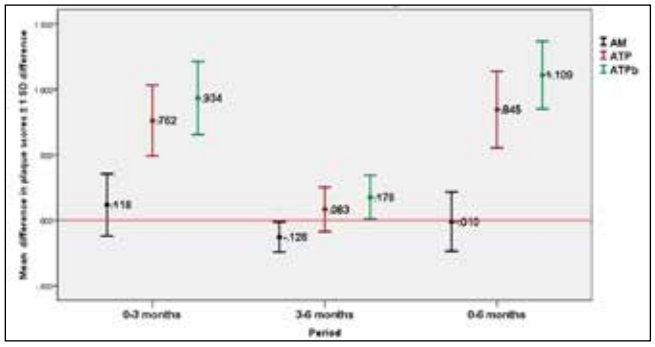


Figure 3. Comparison of the effectiveness of the three oral health education techniques on the oral hygiene status of the partially visually impaired children.



Children with Partial Visual Impairment

During the reinforcement period, the partially visually-impaired children in Group III showed the greatest reduction in scores, with a mean difference of 0.934 ± 0.279. This was followed by Groups II and I, with mean differences of 0.762 ± 0.270 and 0.118 ± 0.237, respectively (Figure 3). There were significant differences in effectiveness within groups during this period (p <0.001) (Table 2). When effectiveness between groups was compared, there were significant differences between Groups I and II and Groups I and III (p <0.001), but not between Groups II and III (p = 0.155) (Table 3).

During the subsequent three-month non-reinforcement period during which no intervention was performed, the greatest reduction in scores was seen in Group III, followed by Group II, with mean differences of 0.176 ± 0.166 and 0.083 ± 0.169, respectively. In Group I, an increase in plaque scores was seen during this period, with a mean difference of -0.128 ± 0.114 (Fig. 3). There were significant differences in effectiveness within groups during this period (p <0.001) (Table 2). In terms of between-group differences, significant differences were noted only between Groups I and II and Groups I and III (p <0.001), with no difference in effectiveness between Groups II and III (p = 0.051) (Table 3).

After six months, the greatest reduction in scores was seen in Group III, with a mean difference of 1.109 ± 0.258, followed by Group II, with 0.845 ± 0.292. However, partially visually-impaired children in Group I showed an overall worsening of scores, with a mean difference of -0.010 ± 0.226 (Fig. 3). There was significant difference in effectiveness within groups (p <0.001) (Table 2). Overall, there were significant differences in effectiveness between Groups I and II, Groups I and III and Groups II and III by the end of the six-month study period (Table 3).

DISCUSSION

The lack of one of the primary senses—in this case, vision—which orients an otherwise healthy individual to their surroundings may be the main reason for poor oral hygiene in the visually impaired. An effective preventive program that focuses on educating and training the child to perform adequate oral hygiene maintenance technique is necessary as such individuals cannot visualise signs of dental disease. [13] We found that adding braille instructions to conventional audio-tactile methods not only resulted in a meaningful reduction in plaque scores, but also continued to improve the scores significantly, even without any additional intervention.

Institutionalised children were chosen in order to avoid any bias in outcome, as all children had similar dietary and oral hygiene practices. Only children aged 6–15 years old were included, as such children would have sufficient manual dexterity to brush their teeth independently and understand instructions clearly.[14,15] Moreover, schools are considered the best environment to teach preventive oral health practices as schoolchildren are already in a learning environment and are easily accessible.[16] The modified Bass technique is superior to the horizontal scrub technique as the former cleanses the proximal areas as well as the gingival third and sulcular regions of the oral cavity.[17,18] However, several studies have reported no significant difference in efficacy between these methods. [19,20] The modified Bass technique, even though time-consuming, was chosen for the current study as it has a wider cleansing zone.

Overall, the oral health status of the visually-impaired children was poor, with a mean baseline plaque score of 2.031 ± 0.411.

Previous research has confirmed that visually-impaired often have poor oral hygiene.[8,21-25] However, Prashanth et al. reported that only 8% of the blind children in their study population had poor oral hygiene.[26] Reasons for poor oral hygiene among visually-impaired children could be the lack of development of necessary self-maintenance skills, inability to see and remove plaque, lack of supervision while brushing, limited intellectual capacity in some children, lack of knowledge regarding oral hygiene and effective tooth brushing and the reduced amount of time spent brushing their teeth.[27-29] Local factors like malocclusion and dental crowding may also lead to the accumulation of plaque, contributing to reduced oral health. However, Mitsea et al. observed better oral hygiene among visually-impaired children in comparison to children with cerebral palsy and mental retardation.[30] Institutionalised blind children may have poorer oral hygiene compared to those who are non-institutionalised, possibly due to a lack of caregiver assistance while brushing and during other oral hygiene practices.[31] Lack of supervision and help from parents may affect factors like brushing technique and motor skills.[25] However, this may not always be true and depends to a large extent on the infrastructure of the institution in question and the enforcement of routine hygiene practices.[32]

There was no significant difference in oral hygiene status of the totally and partially visually-impaired children as a whole and within groups at baseline. In contrast, Bennadi et al. reported an increase in plaque levels among those who were totally blind.[33] This difference in findings in the present study is probably due to the fact that many were classified medically with partial impairment because of an enhanced sensitivity to light rather than an actual improvement in vision.

Conventional methods of oral health education are directed towards visualising and identifying early signs of dental disease. Naturally, this is near impossible for visually-impaired individuals.[26] Hence, customised methods of education and motivation to correct oral hygiene practices are essential to maintain good oral hygiene. The visually-impaired depend on various other sensations such as sound, speech and touch along with kinaesthetic and olfactory sensations to adapt themselves to their immediate surroundings. [34]

In the present study, three different approaches of providing oral hygiene instructions were assessed. In each group, the respective method was reinforced for a period of three months, following which there was no intervention for another three months (the non-reinforcement period). Among the children who received oral health education via a verbal health talk, a reduction in plaque scores was seen during the reinforcement period. However, by the end of the study period, the final scores had worsened in comparison to baseline scores. This suggests that even though this technique was capable of marginally improving oral hygiene status, the children could neither improve nor maintain their oral hygiene without intervention.

In contrast, children who took part in the ATP intervention had significantly reduced plaque scores compared to those receiving AM. Although there was only a marginal improvement seen during the non-reinforcement period, there was a significant improvement in mean plaque scores from baseline by the end of the study. This clearly shows that this technique was very effective if reinforced. In the absence of the intervention, the children could maintain their oral hygiene, but could not improve further. Earlier studies have similarly shown significant improvement in oral hygiene using ATP techniques.[4,11] However, reinforcement in these studies was primarily given by teachers or caregivers and there was no well-demarcated period of reinforcement and non-reinforcement.

Finally, the modified ATP technique with braille resulted in a significant reduction in plaque scores by the end of the reinforcement period. Furthermore, a meaningful improvement in plaque scores was observed even without intervention during the non-reinforcement period. This improvement was greater than that observed in the ATP group during this time, although the difference was not statistically significant. By the end of the study, a significant drop in plaque scores was seen in comparison to baseline scores; moreover, this improvement was greater than that seen during the reinforcement period. Thus, the newly developed technique was very effective in improving and maintaining plaque scores, both with and without reinforcement. The children were able to retain the instructions and incorporate them into their daily practice, thereby considerably improving their oral hygiene.

When the effectiveness of the three techniques was compared, it was observed that the ATPb technique resulted in the greatest reduction in plaque scores during both the reinforcement and non-reinforcement periods. This was probably due to the fact that it was the most customised technique of the three. In addition, the inclusion of braille may have helped to convert the tactile sensations into learned information. Moreover, as the braille pamphlet included a story, it may have been more appealing to the children and therefore better remembered. Possibly, the efficacy of the next best technique, ATP, can be further improved with repeated instructions over longer periods of reinforcement.

Chowdary *et al* showed that combining verbal, braille and tactile oral hygiene instructions most effectively reduced plaque scores compared to verbal and braille or verbal and tactile means.[35] Surprisingly, a study from Hyderabad of four different oral health education techniques found the highest improvement in scores in the audio group, with the least reduction in those who received instructions via braille alone. In this study, the braille group did not receive individualised attention, which may explain their poor performance.[36] Another study found that tactile and auditory means were equally effective in educating and motivating visually-impaired children and that these methods can be made interesting by utilising braille, plastic models, an audio story or the computer software Job Access With Speech (JAWS).[37]

In the current study, the improvement in plaque scores with the modified ATPb intervention was similar in both totally and partially visually-impaired children. However, in a study done by Joybell et al., it was observed that partially blind children mastered brushing techniques better than totally impaired children following oral health education using the ATP technique.[4] Another study found a greater decrease in plaque control record values among partially visually-impaired children following oral health education, with a definite advantage over completely blind children.[34]

In general, the present study clearly indicates that the oral health practices of visually-impaired children can be improved by deviating from traditional approaches of oral health education. We developed a modified ATP technique including braille in order to ensure that visually-impaired children can be taught to perform basic oral hygiene practices independently. Nevertheless, as the study population comprised children from three institutions in three different cities, their dietary and oral hygiene practices could only be standardised to a certain extent; this could be considered a

limitation of our study. We recommend that techniques to educate and train visually-impaired children be customised on an individual basis in accordance with their needs. Though most of the techniques follow the principles of 'tell-feel-do', no standard technique has been adopted so far. ATPb is a step in that direction to formulate a technique that can be used by everyone with ease to create positive impacts on behavioural outcomes. More studies exploring this approach will definitely reveal more interventions, simple and feasible. Newer technologies should be combined with conventional methods for maximum benefit.

CONCLUSION

The present study aimed to develop a new oral health education program for visually-impaired children to ensure adequate oral hygiene maintenance. While all three methods of oral health education—AM, conventional ATP and modified ATPb techniques—were successful in improving oral hygiene status with reinforcement, only the last two improved oral hygiene even during periods of non-reinforcement. However, the newly developed modified technique using braille, ATPb, was the most effective method with the advantage of encouraging retention of the learned information even without intervention.

ACKNOWLEDGEMENTS

We would like to thank the Principals, staff and students of the Calicut Higher Secondary School for the Handicapped, Calicut, Kerala; the Government Blind School, Kasargod, Kerala; and the Roman and Catherine School for the Blind, Mangalore, Karnataka, for their cooperation in this study.

REFERENCES

1. Klingberg G. Children with disabilities. In Wright GZ, Kupietzky A. Behavior management in dentistry for children, Second edition. Ed. John Wiley & Sons Inc, Ames, IA ;93-105, 2014.
2. Pascolini D, Mariotti SP. Global estimates of visual impairment: 2010. Br J Ophthalmol 96:614-8, 2012.
3. Titiyal JS, Pal N, Murthy GV, Gupta SK, Tandon R, Vajpayee RB, Gilbert CE. Causes and temporal trends of blindness and severe visual impairment in children in schools for the blind in North India. Br J Ophthalmol 87:941-5, 2003.
4. Joybell C, Krishnan R, V SK. 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 9:ZC19-22. 2015
5. Bhandary S, Shetty V, Hedge AM, Rai K. Knowledge of care providers regarding the oral health of visually impaired children. J Clin Pediatr Dent 36:411-5. 2012
6. Mohan R, Raju R, Gubbihal R, Kousalya PS. Comprehensive dental care for the visually impaired: A review. Int J Oral Health Med Res 3:97-101. 2016.
7. Hennequin M, Faulks D, Roux D. Accuracy of estimation of dental treatment need in special care patients. J Dent 28:131-6. 2000.
8. Shetty V, Hegde AM, Bhandary S, Rai K. Oral health status of the visually impaired children—a South Indian study. J Clin Pediatr Dent 34:213-6. 2010
9. Chi DL. Oral Health for US children with special health care needs. Pediatr Clin North Am 65:981-93. 2018.
10. Nair DJ, Shetty AA, Hegde AM. Comprehensive dental management of visually impaired children: A brief review. IJMSIR 3:235-43. 2018.
11. Hebbal M, Ankola AV. Development of a new technique (ATP) for training visually impaired children in oral hygiene maintenance. Eur Arch Paediatr Dent 13:244-7. 2012.
12. Silness J, Loe H. Periodontal Disease in Pregnancy. II. Correlation between oral hygiene and periodontal condtion. Acta Odontol Scand 22:121-35.1964
13. Weddell JA, Sanders BJ, Jones JE. Dental problems of children with special health care needs, In McDonald RE , Avery DR, Dean JA. McDonald and Avery's dentistry for the child and adolescent. 9th ed. Ed. Mosby/Elsevier. St. Louis, Mo: 460-86, 2011.
14. Unkel JH, Fenton SJ, Hobbs G, Jr., Frere CL. Toothbrushing ability is related to age in children. ASDC J Dent Child 62:346-8.1995.
15. Choo A, Delac DM, Messer LB. Oral hygiene measures and promotion: review and considerations. Aust Dent J 46:166-73. 2001.
16. Flanders RA. Effectiveness of dental health educational programs in schools. J Am Dent Assoc 114:239-42. 1987
17. Gibson JA, Wade AB. Plaque removal by the Bass and Roll brushing techniques. J Periodontol 48:456-9. 1977
18. Poyato-Ferrera M, Segura-Egea JJ, Bullon-Fernandez P. Comparison of modified Bass technique with normal toothbrushing practices for efficacy in supragingival plaque removal. Int J Dent Hyg 1:110-4. 2003
19. Robinson E. A comparative evaluation of the Scrub and Bass Methods of toothbrushing with flossing as an adjunct (in fifth and sixth graders). Am J Public Health 66:1078-81. 1976
20. Smutkeeree A, Rojlakkanawong 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 21:278-83. 2011.
21. Reddy K, Sharma A. Prevalence of oral health status in visually impaired children. J Indian Soc Pedod Prev Dent 29:25-7. 2011
22. Solanki J, Gupta S, Arora G, Bhateja S. Prevalence of dental caries and oral hygiene status among blind school children and normal children, Jodhpur city: A comparative study. J. Adv. Oral Res 4:1-5. 2013.
23. Ahmad MS Jindal MK, Khan S, Hashmi SH. Oral health knowledge, practice, oral hygiene status and dental caries prevalence among visually impaired students in residential institute of Aligarh. J Dent Oral Hygiene 1:22-6. 2009.
24. Bimstein E, Jerrell RG, Weaver JP, Dailey L. Oral characteristics of children with visual or auditory impairments. Pediatr Dent 36:336-41. 2014.
25. Reddy VK, Chaurasia K, Bhambal A, Moon N, Reddy EK. A comparison of oral hygiene status and dental caries experience among institutionalized visually impaired and hearing impaired children of age between 7 and 17 years in central India. J Indian Soc Pedod Prev Dent 31:141-5. 2013
26. Prashanth ST, Bhatnagar S, Das UM, Gopu H. Oral health knowledge, practice, oral hygiene status, and dental caries prevalence among visually impaired children in Bangalore. J Indian Soc Pedod Prev Dent 29:102-5. 2011.
27. Azrina AN, Norzuliza G, Saub R. Oral hygiene practices among the visually impaired adolescents. Ann Dent Univ Malaya 14:1-6. 2007.
28. Martens L, Marks L, Goffin G, Gizani S, Vinckier F, Declerck D. Oral hygiene in 12-year-old disabled children in Flanders, Belgium, related to manual dexterity. Community Dent Oral Epidemiol 28:73-80. 2000.
29. Yalcinkaya SE, Atalay T. Improvement of oral health knowledge in a group of visually impaired students. Oral Health Prev Dent 4:243-53. 2006.
30. Mitsea AG, Karidis AG, Donta-Bakoyianni C, Spyropoulos ND. Oral health status in Greek children and teenagers, with disabilities. J Clin Pediatr Dent 26:111-8. 2001.
31. Tagelsir A, Khogli AE, Nurelhuda NM. Oral health of visually impaired schoolchildren in Khartoum State, Sudan. BMC Oral Health 13:33. 2013.
32. Jain A, Gupta J, Aggarwal V, Goyal C. To evaluate the comparative status of oral health practices, oral hygiene and periodontal status amongst visually impaired and sighted students. Spec Care Dentist 33:78-84. 2013.
33. Bennadi D Mythri H, Bharateesh JV. Dental Negligence among visually impaired children – a call for attention. RRJDS 1:26-8. 2013.
34. Kumar RK, Fareed N, Shanthi M. The effectiveness of oral health education program with and without involving self-maintainable oral hygiene skills among the visually impaired children. Int J of Scientific Study 1:51-9. 2013.
35. Chowdary PB, Uloopi KS, Vinay C, Rao VV, Rayala C. Impact of verbal, Braille text, and tactile oral hygiene awareness instructions on oral health status of visually impaired children. J Indian Soc Pedod Prev Dent 34:43-7. 2016.
36. Ganapathi AK, Namineni S, Vaaka PH, Das R, Devi M, Akkaloori A, Kumbakonam A. Effectiveness of various sensory input methods in dental health education among blind children- A comparative study. J Clin Diagn Res 9:ZC75-8. 2015
37. Sardana D, Goyal A, Gauba K, Kapur A, Manchanda S. Effect of specially designed oral health preventive programme on oral health of visually impaired children: use of audio and tactile aids. Int Dent J 69:98-106. 2019.