Systematic Review

Visual strategies for managing dental fear and anxiety (DFA) among individuals with hearing impairment: a systematic review

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ABSTRACT

Introduction: Dental fear and anxiety (DFA) pose significant challenges in treating patients, including individuals with hearing impairments. Visual aids have been reported to be helpful in modifying hearing-impaired people's behavior. This study aimed to assess the effectiveness of visual strategies in reducing DFA among people with hearing impairments. **Method:** A literature search was conducted across five research databases, PubMed, ProQuest, EBSCOhost via Medline, Cochrane, and Scopus, within a restricted publication timeframe. The inclusion criteria were as follows: studies published between 1st January 2013 and 31st July 2024, English language, and primary data studies. We used the PICOS concept, with the population referring to people with hearing impairment and the intervention referring to only a visual strategy to manage DFA. Screening involved eliminating studies that did not meet the eligibility criteria, and the quality of the paper was appraised via validated instruments appropriate for study design, including RoB-2 and ROBINS-I. Data extraction was accomplished by identifying important information such as author, year, study design, key findings and conclusions. Thematic content analysis was performed via Atlas.ti software. **Results:** The search identified 133 studies, and a total of six studies were included after the screening process. There were three main themes regarding visual strategies aimed at managing dental anxiety: visual aids (2D and 3D books, VR eyewear, videos with or without eyewear), sign language, and customized educational demonstrations. Good patient-f communication and the application of visual strategies significantly reduce DFA. The strategies were shown to be effective; however, the heterogeneity in the included studies precluded a meaningful meta-analysis. The quality assessment results revealed that only one study had a low risk of bias. **Conclusion:** Visual strategy play crucial role in managing DFA in hearing-impaired individuals. Further research, particularly involving different age groups and rigorously designed long-term trials is recommended.

KEYWORDS

Hearing impairment, visual aid, dental anxiety, dental fear

INTRODUCTION

Dental fear and anxiety (DFA) are widespread concerns worldwide. The estimated global prevalence of high and severe DFA in adults ranges from 3.3% to 15.3%. Women and younger individuals are more likely to experience a higher prevalence of DFA.[1] Among children aged 2 to 6 years, the global prevalence of DFA is estimated to be 30%, and children without prior dental visit experiences and with dental caries are more likely to experience DFA.[2] A previous cross-sectional study

in Romania reported that more than half of young deaf adults feared dental treatment due to tooth drilling or anaesthetic injections, which could lead to delayed or missed dental visits.[3] Several factors contribute to the presence of DFA, including age, sex, previous dental experiences, insurance, and socioeconomic status.[4] Furthermore, various assessment instruments and procedures for evaluating DFA exist that contribute to the variations in its reported prevalence.[1]

Dental fear and anxiety pose significant barriers to dental visits, leading to delayed or avoided appointments and subsequent deterioration of oral health.[5] A lack of routine dental check-ups can lead to more invasive procedures and increased dental phobia.[6] A previous study revealed that higher levels of dental anxiety are associated with poorer the oral health-related quality of life.[7] Dental fear and anxiety are related to other factors, such as oral health behavior and dental attendance.[8] DFA continues to present challenges for dental professionals, resulting in longer treatment times and decreased cooperation among patients.[7,9]

Among individuals with hearing impairment, DFA becomes a barrier that prevents them from accessing dental treatment. A study by Suhani et al. revealed that approximately 60% of deaf participants experienced dental fear and anxiety, and a greater percentage of such fear and anxiety was reported among individuals with previous traumatic dental treatment.[3] Therefore, understanding how to manage DFA during dental care treatment is critical, especially for patients with special needs.

There are several strategies for managing dental fear and anxiety.[10,11] The primary goal is to create a welcoming environment in the dental clinic and establish effective communication between patients and dentists.[12] Vaarious techniques, including hypnotherapy, relaxation, acupuncture, distraction, positive reinforcement, and cognitive therapy are employed to manage dental anxiety related to dental treatment.[10,13] Psychotherapeutic behavioral strategies can help alleviate DFA through minimal intervention with little to no side effects, depending on the patient's characteristics, anxiety level, and clinical circumstances.[11]

Additionally, virtual reality technology has been successfully used to reduce patient pain and anxiety during dental implant procedures.[14] However, some treatments have limitations, and pharmacological interventions carry risks, undesirable effects, and contraindications. As a result, dentists and dental teams should devote greater attention to following treatment and providing adequate methods.[11]

People with hearing impairment are particularly susceptible to mental health issues, including anxiety, which varies among individuals.[15] Visual strategies, such as visual aids, virtual reality (VR) goggles, picture books, and sign language, have demonstrated effectiveness in reducing DFA among patients with hearing impairments.[14,16,17] These approaches are cucial since DFA are linked to general anxiety and are very common among this population. However, despite their potential, research on visual strategies for reducing DFA among hearing-impaired people has been very limited.[17,18]

Further exploration of this topic will provide valuable evidence for designing more comprehensive and appropriate treatments to reduce DFA, especially among special needs patients. This study aimed to assess the effectiveness of visual strategies in reducing DFA among individuals with hearing impairments through a systematic review of the relevant literature.

METHODS

The study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.[19] The protocol was registered on the International Prospective Register of Systematic Reviews (PROSPERO) under registration number CRD42024589758. The overarching research question was formulated using the PICO framework (participants, intervention, comparator, and outcomes), with the primary question stated as follows: *What visual strategies*

can be used to manage dental fear and anxiety among individuals with hearing impairment? Given the limited number of studien on DFA in individuals with hearing impairment, this review included participants across all age groups and all degrees of hearing impairment. This study focuses on answering a question based on the PICO concept, with "population" defined as a person with hearing impairment (all degrees of hearing impairment, without other disability), "intervention" as a visual strategy, "comparator" as a treatment except visual strategy, and "outcome" as dental fear and anxiety.

No restriction were imposed on age group or degree of hearing impairment. Only studies utilizing primary data, Particularly those involving interventions, were included. We excluded the following categories of articles: (1) articles that did not fit within the conceptual framework of the study; (2) systematic review articles; and (3) animal studies, case reports, case series, conference proceedings, editorials, letters to editors, dissertations, theses, and commentaries.

The number of included studies was documented, along with those that did not meet the eligibility criteria. All studies identified through the search strategy were imported into rayyan.ai for duplicate removal and eligibility screening. Zotero 6.0.36 was used for the reference manager. The selected papers underwent full-text analysis and were thoroughly, critically, and objectively reviewed and discussed. The findings were then compiled into a comprehensive explanation of the results.

The literature search was performed across five databases: PubMed, the Cochrane Library, EBSCOhost via Medline, Scopus, and ProQuest. Preliminary literature research was conducted to formulate a Boolean logic search. Hence, we adopted strategies from previous studies. We used keywords based on MeSH terms with Boolean logic: (Hearing Impair* OR Hearing Loss OR Hearing Disabled Person OR Deaf Person OR Hard of Hearing Person) AND (Visual Aid OR Video Games OR Illustrated Books OR Comic Books OR Video OR Virtual Reality) AND (Dental Anxiety OR Dental Phobia OR Dental Fear).

For Scopus, we used the following search strategy: (TITLE-ABS-KEY (hearing AND impairment) OR TITLE-ABS-KEY (hearing AND loss) OR TITLE-ABS-KEY (hearing AND disabled AND person) OR TITLE-ABS-KEY (deaf AND person) OR TITLE-ABS-KEY (hard AND of AND hearing)) AND (TITLE-ABS-KEY (video AND games) OR TITLE-ABS-KEY (video) OR TITLE-ABS-KEY (virtual AND reality) OR TITLE-ABS-KEY (illustrated AND books) OR TITLE-ABS-KEY (comic AND books) OR TITLE-ABS-KEY (visual AND aid)) AND (TITLE-ABS-KEY (dental AND phobia) OR TITLE-ABS-KEY (dental AND anxiety) OR TITLE-ABS-KEY (dental AND fear)).

The search was restricted to publications in English, published between 1st January 2013 and 31st July 2024, and related to the subject areas of 'dentistry' and 'hearing loss. Finally, all articles with indexed abstracts in the databases were identified and retrieved. After duplicates were removed, the titles and abstracts of the remaining articles were reviewed.

After the literature from previous steps was gathered, two reviewers (M.O. and P.M.A.) performed the screening in two steps via the website rayyan.ai. First, we screened all the studies by title and abstract. Second, we assessed the full-text versions. All narrative and systematic reviews were also excluded. Any disagreements between the two reviewers were resolved by discussion, and a consensus was reached in the presence of a third reviewer (A.R.D.).

For the risk of bias assessment, all included randomized controlled trials were examined using the Cochrane risk-of-bias tool for randomized trials version 2 (RoB-2).[20] The studies were classified as having 'low', 'some concerns', or 'high' risk of bias based on RoB-2's five bias-related domains including randomization, deviations from intended interventions, missing outcome data, outcome measurement, and reported results. The studies were categorized as having a 'low', 'some concerns' or 'high' risk of bias.[20]

The Risk of Bias in Nonrandomized Studies - of Interventions (ROBINS-I) tool was used to assess the quality of nonrandomized clinical trials.[21] The ROBINS-I tool examines seven domains including bias due to confounding, selection of participants into the study, classification of intervention, deviations from intended intervention, missing data, measurement of outcome, and selection of the reported result. The results were classified as having no information or a 'low', 'moderate', 'serious', or 'critical' risk of bias.[21]

The quality assessment was conducted by two reviewers (M.O. and P.M.A.), and if there was any disagreement between the two reviewers, a consensus was reached following discussion.Data were extracted using a data-charting form in Microsoft Excel. The extracted data included information about the first author, country, year, aim, study design, key findings, and conclusion. Finally, thematic analysis[22], conducted via Atlas.ti was used to classify the data obtained from the previous step, summarize the major findings, and provide a narrative description of the existing evidence regarding visual strategies for managing DFA among hearing-impaired individuals.

RESULTS

According to the PRISMA flowchart (Figure 1), 133 studies were screened, and six studies were included in this review.[16,17,23-26] The remaining studies were excluded because they did not fit the eligibility criteria or could not be retrieved. Five randomized controlled trial (RCT) studies were included[16,17,23-25], and one nonrandomized trial study was also included.[26] All the studies were conducted on populations of children with hearing impairments, ranging in age from 5 to 12 years old. The original studies were conducted in three different countries: the United Arab Emirates (UAE)[24], India[16,17,23], and Indonesia[25,26] (Table 1). The sample sizes ranged from 15 to 42 children with hearing impairments. All included articles were published between 2016 and 2023. The risk of bias was assessed using RoB-2[20] for randomized controlled trials, which revealed that only one study[23] had a low risk of bias (Table 2). One nonrandomized controlled trial[26] showed a serious risk of bias based on the ROBINS-I assessment tool[21]. (Table 3)

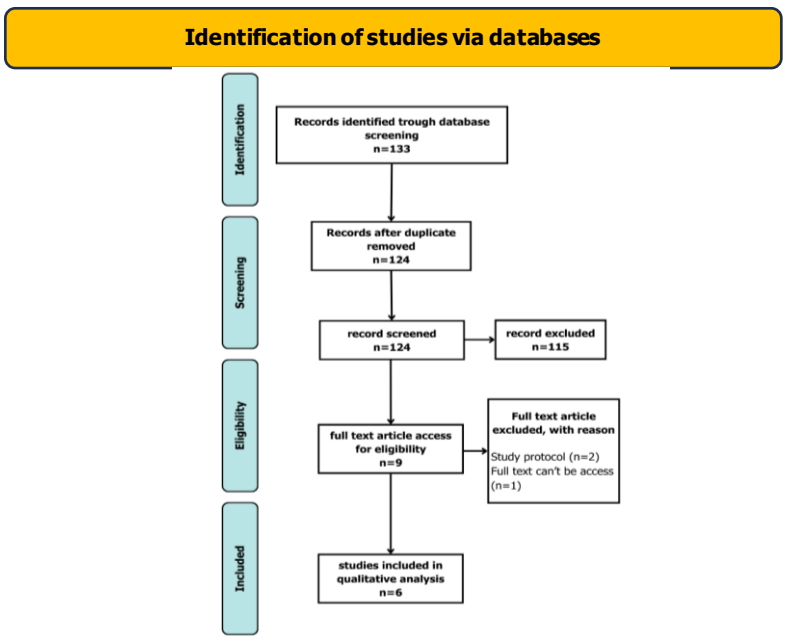

Figure 1. The systematic flow of the literature search

Table 4 presents a comprehensive list of three main themes regarding the visual strategies used to reduce dental anxiety: visual aids, sign language, and customized educational demonstrations. These themes consist of four subthemes and six final codes. The first code is visual aids: the majority of the studies used visual aids with or without sign language as visual strategies, including 2D and 3D books[25,26], videos with or without eyewear tools[24], and visual distractions with or without VR glasses or eyewear.[17]

The second code is sign language: one study[16] used dental sign language before dental treatment. Finally, customized educational demonstrations: a few studies have used modified educational demonstrations, such as the modified tell-show-do (MTSD).[23,24]

Visual aids were used in most of the studies, and they varied from picture books to videos as a distraction during the dental treatment.[17,23-26] Picture books were identified in two studies.[25,26] A previous study revealed that educational pop-up books significantly reduced breathing frequency compared to the control group (p = 0.001).[25]

No statistically significant difference (p > 0.05) was found between the two-dimensional and three-dimensional picture books.[26] They had the same effect on reducing breathing frequency and Salivary Alpha-Amylase (SAA) levels in hearing-impaired children.[26]

A visual distraction method was used to watch videos with or without virtual reality (VR) glasses.[17,23,24] A prior crossover study revealed that when children watched videos through video eyewear, the mean differences in heart rate, pulse oximeter, and facial pain scores increased.[24] In contrast, studies by Kaur J et al. (2021)[17] and Varshitha et al. (2023)[23] revealed that VR glasses significantly reduce the degree of dental anxiety in hearing-impaired children.

The use of VR glasses along with modified tell-show-do (MTSD) reduced the pulse rate (PR) and facial image scale (FIS) scores, with mean differences of 6.95 ± 10.70 (p = 0.009) and 2.15 ± 0.75 (p = 0.001), respectively.[23] A study[17] that used VR glasses to watch educational videos with sign language interpretation reported that the mean difference in anxiety score decreased from baseline to post-treatment (1.87, p = 0.011) .[17]

Sign language during treatment effectively reduced blood pressure, PR, and FIS scores of hearing-impaired children.[16] The mean of FIS and PR after treatment between the control and study groups decreased from 3.1 to 1.05 and from 94.65 to 85.55, respectively.[16]

Table 1. Study characteristics

Author, years, country	Study Design	Sample size, Age group	Aim	Result and Key Finding	Conclusion
Fakhruddin KS, 2016, UEA[24]	RCT	n = 15, children (age 5-7 years)	To assess the effectiveness of behavioral modification technique combined with/without visual distraction video eyewear using Computerized Delivery System Intrasulcular System (CDS-IS) during the application of local anesthetic in hearing-impaired children during pulp treatment of primary molars.	Group A: Session II: watch video with VR glasses Session III: watch video without VR glasses A significant increase of pulse rate, change in heart rate, and faces scale pain were observed while watching the video using VR glasses in group A ($p < 0.05$). Group B: Session II: watch video without VR glasses Session III: watch video with VR glasses No statistically significant difference in pulse rate, change in heart rate, and faces scale pain in group B ($p > 0.05$)	Complete visibility of the surrounding environment, routine psychological approach (Tell Show Do) and the use of CDS-IS for local anesthesia are recommended for reduced dental anxiety among children with hearing impairment.
Chandrasekhar S, 2017, India[16]	RCT	n= 40, children (age 6-12 years)	To evaluate implication of dental sign language for children with hearing impairment in reducing dental anxiety by improving communication	Significant reduction in anxiety levels, as indicated by blood pressure, Facial Image Scale, and pulse rate, from pretreatment to posttreatment in the study group ($p < 0.05$). However, no significant difference was observed between pretreatment and posttreatment in the control group.	The use of sign language is effective in reducing dental anxiety for children with hearing impairment.
Susilo CW, 2018, Indonesia[25]	RCT	n=42, children (age 7-9 years)	To assess the impact of educational pop-up book on dental anxiety in hearing impaired children by observing respiratory rate assessment	The unpaired t-test of delta respiratory rate between study and control group show significant difference between control and intervention group. The delta value of respiratory rate (after – before) of intervention group was -3.83 ± 4.8 while control group was 0.441 ± 1.67 ($p = 0.001$)	Educational pop-up book effectively helps children with hearing impairment to reduce dental anxiety.
Kaur J, 2021, India[17]	RCT	n=24, children (age 6-12)	To assess effectiveness of visual distraction with and without VR glasses in reducing dental anxiety among hearing-impaired children	The VR glasses group showed a significant decrease in anxiety levels during and after dental treatment, compared to the control group and the group without VR glasses. Anxiety score of group A (control group) Baseline = 3.38 ± 0.518 During treatment = 3.50 ± 1.31 After treatment = 1.88 ± 1.13 $p = 0.007$ Anxiety score of group B (watch video with VR glasses)	Along with clear instruction, the use of virtual reality glasses effectively decreased dental anxiety in children with hearing impairments.

				Baseline = 3.00 ± 0.76 During treatment = 2.25 ± 0.89 After treatment = 1.13 ± 0.35 p = 0.001 Anxiety score of group B (watch video without VR glasses) Baseline = 3.25 ± 0.71 During treatment = 2.88 ± 0.64 After treatment = 2.38 ± 0.92 p = 0.152	
Fauziah E, 2019, Indonesia[26]	Non-Randomized Controlled Trials	n=42, children (age 7-9 years)	To compare the effect of three-dimensional and two-dimensional educational book "Aku dan Gigiku" on dental anxiety	There is no significant difference in respiratory rate and salivary alpha-amylase (SAA) levels between intervention group (3D book) and control group (2D book). However, significant difference was noted in electrodermal activity between the groups. The delta value of respiratory rate in intervention group (3D book) was -3.837 ± 4.808 while control group's (2D book) was -1.174 ± 1.169 (p = 0.062). The value of SAA Levels in intervention group was 16 (−7–69) while control group was -11 (−11–26) with p 0.199.	The two- and three-dimensional book "Aku dan Gigiku" has a positive effect on reducing dental anxiety by decreasing breathing frequency, SAA levels, and electrodermal activity.
Varshitha K, et al. 2023, India[23]	RCT	n=40, children (age 6-11)	To assess effectivity of distraction using VR glasses with Tell-Show-Do (MTSD) method on hearing impaired children anxiety level during noninvasive dental treatment	A significant reduction of pulse rate (PR) and Facial Image Scale (FIS) scores was observed when using Virtual Reality (VR) glasses along with MTSD in the posttreatment ($p < 0.05$).	Distraction using VR glasses and MTSD effectively reduced hearing-impaired children (age 6–11-year-old) anxiety levels compared to MTSD only.

Table 2. Cochrane risk of bias assessment for randomized clinical trials (RoB 2)

	D1	D2	D3	D4	D5	Overall
Fakhruddin et al. (2016)	!	!	+	+	!	!
Chandrasekhar et al. (2017)	!	!	+	+	!	!
Susilo et al. (2018)	!	!	+	+	!	!
Kaur et al. (2021)	+	!	+	+	!	!
Varshitha et al. (2023)	+	+	+	+	+	+

D1: Randomization process, D2: Deviations from intended interventions, D3: Missing outcome data
D4: Measurement of the outcome, D5: Selection of reported results
Judgment
Low risk
Some concerns
High risk

Table 3. Risk of Bias Assessment of Nonrandomized Trials (ROBINS-I)

	D1	D2	D3	D4	D5	D6	D7	Overall
Fauziah et al. (2019)	X	+	+	+	+	−	−	X

D1: Bias due to confounding factors, D2: Bias in the selection of participants into the study
D3: Bias in the classification of interventions, D4: Bias due to deviations from intended interventions
D5: Bias due to missing data, D6: Bias in measurement of outcomes
D7: Bias in the selection of the reported result
Judgment
Low
Moderate
Serious
Critical

Table 4. Thematic analysis

Themes	Subthemes	Codes	References	Key findings
Visual aids with or without sign language	Picture books	Two-dimensional book	(26)	A reduction in pre- and post- intervention was observed. Two-dimensional book has positive effect on reducing dental anxiety among hearing-impaired children
		Three-dimensional book	(25,26)	A significant difference of respiratory rate was found between the study and control group. The pop-up (three-dimensional book was found to be effective as a visual education tool to reduce dental anxiety in children with hearing impairment.
	Visual distraction using video	Video with or without eyewear tool	(24)	Visual distraction using video eyewear that blocks real-world visual and auditory stimuli, increased the heart rate and might trigger anxiety among hearing-impaired children.
		Video with or without Virtual reality (VR) glasses or eyewear	(17,23)	Visual distraction using VR glasses or eyewear, with or without MTSD, is an effective technique in reducing dental anxiety among children with speech and hearing disabilities.
Sign language	sign language	Dental sign language	(16)	Facial image scale and pulse rate were significantly higher in the control group during and after treatment. Dental sign language improved children's positive behavior and dental attitude.
Customized educational demonstration	Tell-Show-Do	Modified Tell-Show-Do (MTSD) with or without sign language	(23,24)	Routine MTSD intervention along with visual distraction while maintaining full visibility of the surroundings and using a Computerized Delivery System-Intrasulcular (CDS-IS) for local anesthesia, is effective for children with hearing impairment.

DISCUSSION

Individuals with hearing impairment are more susceptible to alienation and other negative circumstances, including psychological distress.[3] They avoid dental treatment because of their fear and anxiety.[27] This systematic review evaluated the ability of visual strategies to reduce dental anxiety among people with hearing impairment. Many studies have explored the use of visual aids, such as picture books[25,26], educational videos[23], and visual distractions[17,24], as effective methods for managing dental anxiety in hearing-impaired children. An educational pop-up book or two-dimensional book has been shown to reduce dental anxiety among children with hearing impairments.[25,26] Educational picture books, as visual education tools, provide engaging preparatory information to help children become familiar with dental care in clinical settings.[25] A previous study revealed that the use of either two- or three-dimensional books did not result in significant difference in reducing dental anxiety among hearing-impaired children (aged 7–9 years).[26]

The use of VR glasses is well known as an effective strategy for managing pain and anxiety in various medical treatments.[28] In this review, two studies utilized video eyewear and VR glasses, yielding different outcomes. A study by Varshitha and Kaur et al.[17,23] showed that VR glasses effectively reduced dental fear and anxiety in hearing-impaired children during noninvasive treatment by blocking the peripheral vision of the children.

The hearing-impaired children focused on watching the video rather than the dental treatment, and sign language was incorporated to facilitate effective communication.[17,23] In contrast, another study[24] found that video eyewear in children with hearing impairments obstructed the visual field, making them more likely to be startled or alarmed when touched without prior visual contact.

This could be attributed to the video's eyewear's complete blockage of the surrounding visual field, which may induce anxiety in children with hearing

impairment, who may interpret and express it as pain.[24] Various visual aids have been employed to prepare children for dental treatment. Dental models and graphic animations have also been used to influence the behavior of children with hearing impairment regarding dental treatment. [24] Additionally,video-based tools provides visual information that helps hearing-impaired children become famliar with dental procedures, aiding in desensitization toward dental treatment.[24,27]

A previous study revealed sign language to be the most commonly used method for sensory substitution in individuals with hearing loss.[29] Sign language plays a crucial role in providing better care for patients with hearing impairments, followed by additional adjustments based on their preference, such as lip reading.[30] This finding consistent with a previous study, which found that the use of sign language by a dentist reduced DFA in the intervention group compared to the control group.[16] This might occur because patients with hearing impairments experience anxiety when faced with uncertainty; hence, the dentist should inform the patient of everything.[30]

Early access to sign language can support cognitive development in hearing-impaired newborns.[29] Learning sign language significantly enhances the development of young individuals with hearing impairments.[31] However, since sign language varies by region, standardizing a specific sign language for the entire population is challenging.[32] Another challenge in sign language is the shortage of trained personnel to interact with hearing-impaired individuals.[33] The tell-show-do method, when combined with sign language, enhances communication and fosters trust between the children and the dentist.[23] Dentists are encouraged to learn sign language and actively engage with hearing-impaired communities.

The tell-show-do (TSD) method is widely recognized as an effective approach for reducing DFA in children.[34] A case study by Renahan et al. demonstrated that this technique effectively modified patients' behavior toward dental treatment and can be implemented during orientation appointments.[35] We sought to familiarize young toddlers with dental procedures using nonverbal communication, including video demonstrations. Effective communication in the dental setting fosters a child's trust, cultivates a positive attitude, and creates a lasting impression. The tell-show-do (TSD) technique is the most widely utilized method for establishing rapport with children.[23]

The limitation of this review is that all included studies were conducted exclusively on hearing-impaired children (ages 5–12 years). This rigorous review incorporated a comprehensive literature search and a risk of bias assessment. However, only one study was identified as having a low risk of bias. A major drawback of this review was the heterogeneity caused by variations in assessment methods and instruments among the selected studies, which reduced the effectiveness of integrating tools and estimators in meta-analysis.

Further studies on strategies to reduce DFA are highly recommended, with larger sample sizes, broader age distributions among individuals with hearing impairment, and rigorously designed long-term trials. This systematic review highlights additional visual strategies for managing DFA in children, which may be triggered during dental treatment. Dentists should utilize visual aids such as picture books and videos (with or without any device for peripheral vision occlusion) to maintain children's focus and reduce anxiety.[17,23-26] Additionally, dentists can use sign language for hearing-impaired individuals, ensuring clear instructions and fostering positive attitudes toward dental treatment.[16,17]

CONCLUSION

A visual intervention strategy plays a crucial role in managing dental fear and anxiety in patients with hearing impairment, particularly children. The clinical implication of this study is that tailored oral health services and initiatives should be developed to enhance access to and delivery of basic oral healthcare. Moreover, fostering effective patient-centered communication and incorporating

visual aid strategies during treatment can significantly reduce DFA. Further research on the application of these strategies in other age groups is recommended.

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REFERENCES

1. Silveira ER, Cademartori MG, Schuch HS, Armfield JA, Demarco FF. Estimated prevalence of dental fear in adults: A systematic review and meta-analysis. J of dentistry. 2021;108:103632. https://doi.org/10.1016/j.jdent.2021.103632
2. Sun IG, Chu CH, Lo ECM, Duangthip D. Global prevalence of early childhood dental fear and anxiety: A systematic review and meta-analysis. J of dentistry. 2024;142:104841. https://doi.org/10.1016/j.jdent.2024.104841
3. Suhani RD, Suhani MF, Badea ME. Dental anxiety and fear among a young population with hearing impairment. Clujul Med. 2016;89(1):143-9. https://doi.org/10.15386%2Fcjmed-556
4. Prihastari L, Iswara, R. A., Al Afiani, G., Ramadhan, F., Octaviani, M., Hidayat, W. A., Al Faqih, M., & Ronal, A. The relationship between dental fear, anxiety and sociodemography in Jakarta, Indonesia. Dental Journal. 2020;S3(4):175-80. https://doi.org/10.20473/j.djmkg.v53.i4.p175-180
5. Murad MH, Ingle NA, Assery MK. Evaluating factors associated with fear and anxiety to dental treatment—A systematic review. J of Family Medicine and Primary Care. 2020;9(9):4530-5. https://doi.org/10.4103/jfmpc.jfmpc_607_20
6. Appukuttan D. Strategies to manage patients with dental anxiety and dental phobia: literature review. CCIDE. 2016;8:35-50. https://doi.org/10.2147/ccide.s63626
7. Winkler CH, Bjelopavlovic M, Lehmann KM, Petrowski K, Irmscher L, Berth H. Impact of Dental Anxiety on Dental Care Routine and Oral-Health-Related Quality of Life in a German Adult Population-A Cross-Sectional Study. J Clin Med. 2023;12(16):5291. https://doi.org/10.3390/jcm12165291
8. Stein Duker LI, Grager M, Giffin W, Hikita N, Polido JC. The Relationship between Dental Fear and Anxiety, General Anxiety/Fear, Sensory Over-Responsivity, and Oral Health Behaviors and Outcomes: A Conceptual Model. Int J Environ Res Public Health. 2022;19(4):2380. https://doi.org/10.3390/ijerph19042380
9. Sivaramakrishnan G, Makki H, AlDallal S, Alaswad Z, Sultan E, Ahmed S, AlBanna H, Alsobaiei M, AlSalihi L. The variables associated with dental anxiety and their management in primary care dental clinics in Bahrain: a cross-sectional study. BMC Oral Health. 2022 ;22(1):137. https://doi.org/10.1186/s12903-022-02173-7
10. Appukuttan DP. Strategies to manage patients with dental anxiety and dental phobia: literature review. Clin Cosmet Investig Dent. 2016;8:35-50. https://doi.org/10.2147/ccide.s63626
11. Hoffmann B, Erwood K, Ncomanzi S, Fischer V, O'Brien D, Lee A. Management strategies for adult patients with dental anxiety in the dental clinic: a systematic review. Aust Dent J. 2022;67 Suppl 1(Suppl 1):S3-s13. https://doi.org/10.1111/adj.12926
12. Yuan S, Freeman R, Hill K, Newton T, Humphris G. Communication, Trust and Dental Anxiety: A Person-Centered Approach for Dental Attendance Behavioours. Dent J (Basel). 2020;8(4):118. https://doi.org/10.3390/dj8040118
13. Allan FK, Peckham E, Liu J, Dietz KC, Zhang T, Arakaki A, et al. Acupuncture for anxiety in dental patients: Systematic review and meta-analysis. European J of Integrative Medicine. 2018;20:22-35. http://dx.doi.org/10.1016/j.eujim.2018.03.008
14. Ghobadi A, Moradpoor H, Sharini H, Khazaie H, Moradpoor P. The effect of virtual reality on reducing patients' anxiety and pain during dental implant surgery. BMC Oral Health. 2024;24(1):186. https://doi.org/10.1186/s12903-024-03904-8
15. Ariapooran S, Khezeli M. Symptoms of anxiety disorders in Iranian adolescents with hearing loss during the COVID-19 pandemic. BMC Psychiatry. 2021;21(1):114. https://doi.org/10.1186/s12888-021-03118-0
16. Chandrasekhar S, Madu GP, Ambati NR, Suravarapu PR, Uppu K, Bolla D. Pioneering Strategies for Relieving Dental Anxiety in Hearing Impaired Children: a Randomized Controlled Clinical Study. J Dent (Shiraz). 2017;18(2):112-7.
17. Kaur J, Shivashankarappa PG, Sanguida A, Suganya M, Ezhumalai G. Effectiveness of Visual Distraction with and without Virtual Reality Glasses in Reducing Dental Anxiety among Children with Hearing and Speech Disability: A Pilot Study. Int J Clin Pediatr Dent. 2021;14(Suppl 2):S162-s6. https://doi.org/10.5005%2Fjp-journals-10005-2100
18. Gozin F, Tabe Bordbar F, Esmaeili M. Audio-visual storytelling for reducing dental anxiety in Iranian children: a randomized controlled trial. Eur Arch Paediatr Dent. 2022;23(6):953-60. https://doi.org/10.1007/s40368-022-00742-6
19. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. https://doi.org/10.1136/bmj.n71
20. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomized trials. Bmj. 2019;366:l4898. https://doi.org/10.1136/bmj.l4898

21. Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in nonrandomized studies of interventions. BMJ. 2016;355:i4919. Published 2016 Oct 12. https://doi.org/10.1136/bmj.i4919
22. Naeem, M., Ozuem, W., Howell, K., & Ranfagni, S. A Step-by-Step Process of Thematic Analysis to Develop a Conceptual Model in Qualitative Research. Int Journal of Qualitative Methods. 2023;22:1-8. https://doi.org/10.1177/16094069231205789
23. Varshitha K, Uloopi KS, Vinay C, RojaRamya KS, Chaitanya P, Ahalya P. Effectiveness of Distraction with Virtual Reality Eyewear in Managing 6-11-year-old Children with Hearing Impairment during Dental Treatment: A Randomized Controlled Trial. Int J Clin Pediatr Dent. 2023;16(6):820-3. https://doi.org/10.5005%2Fjp-journals-10005-2588
24. Fakhruddin KS, Gorduysus MO, El Batawi H. Effectiveness of behavioral modification techniques with visual distraction using intrasulcular local anesthesia in hearing disabled children during pulp therapy. Eur J Dent. 2016;10(4):551-555. https://doi.org/10.4103/1305-7456.195159
25. Susilo CW, Fauziah E, Rizal MF, Suharsini M, editors. Impact of Using an Educational Pop-up Book to Address Dental Anxiety in Hearing Impaired Children. Journal of International Dental and Medical Research. 2018;11(1):135-138
26. Fauziah E, Rachmawati S, Rachmadani AP, Susilo CW. Comparison of the Educational Effect of Two and Three Dimensional Books on Dental Anxiety in Children With Hearing Impairment (Aged 7–9 Years). Journal of International Dental and Medical Research. 2019;12(4):1507-1510. https://doi.org/10.5958/0976-5506.2019.01627.9
27. Custódio NB, Costa FDS, Cademartori MG, da Costa VPP, Goettems ML. Effectiveness of Virtual Reality Glasses as a Distraction for Children During Dental Care. *Pediatr Dent*. 2020;42(2):93-102.
28. Ahmadpour N, Keep M, Janssen A, Rouf AS, Marthick M. Design Strategies for Virtual Reality Interventions for Managing Pain and Anxiety in Children and Adolescents: Scoping Review. JMIR Serious Games. 2020;8(1):e14565. https://doi.org/10.2196/14565
29. World Health Organization. *World report on hearing*. World n71. Health Organization; 2021.
30. Ahmed TA, Bradley N, Fenesan S. Dental management of patients with sensory impairments. Br Dent J. 2022;233(8):627-33. https://doi.org/10.1038%2Fs41415-022-5085-x
31. Murray JJ, Hall WC, Snoddon K. Education and health of children with hearing loss: the necessity of signed languages. *Bull World Health Organ*. 2019;97(10):711-716. https://doi.org/10.2471/BLT.19.229427
32. Gupta L, Jain P, Mora LN, Mujho T. Evaluation of different visual method used, to enhance communication skills between dental care providers and speech and hearing-impaired patients. *Indian J Dent Res*. 2018;29(4):418-422. https://doi.org/10.4103/ijdr.IJDR_741_16
33. Saikiran KV, Kamatham R, Sahiti PS, Nuvvula S. Impact of educational (sign language/video modeling) and therapeutic (Glycyrrhiza glabra–liquorice mouth wash) interventions on oral health pertaining to children with hearing impairment: a randomized clinical trial. *Spec Care Dentist*. 2019;39(5):505-514. https://doi.org/10.1111/scd.12404
34. Elicherla NR, Saikiran KV, Anchala K, Elicherla SR, Nuvvula S. Evaluation of the effectiveness of tell-show-do and ask-tell-ask in the management of dental fear and anxiety: a double-blinded randomized control trial. J Dent Anesth Pain Med. 2024;24(1):57-65. https://doi.org/10.17245/jdapm.2024.24.1.57
35. Renahan N, Varma RB, Kumaran P, Xavier AM. Unique Approach to Dental Management of Children with Hearing Impairment. Int J Clin Pediatr Dent. 2017;10(1):107-10. https://doi.org/10.5005%2Fjp-journals-10005-1417