

Impact of an Auditory Mediated Patient Health Education (PHE) Program on Treatment Compliance and Satisfaction Among Patients Seeking Prosthodontic Care During COVID Pandemic – A Prospective Interventional Study

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Background: Patients health education by healthcare workers has been affected by pandemic guidelines. This study aimed to evaluate the influence of an audio-mediated intervention for patient health education (PHE) on treatment compliance and treatment satisfaction among patients seeking prosthodontic treatment during the Covid pandemic.

Methods: A total of 666 patients (aged 40–70 years) who fulfilled the study criteria were treated for denture-associated disease. PHE for 5 different categories was performed using an educational audio (MP3) in the experimental group (Group E), and traditional methods (oral/verbal) in the control group (Group C). Patient/clinician satisfaction with the PHE program was evaluated with a pre-validated questionnaire, whereas treatment compliance and satisfaction were evaluated using a denture hygiene index (DHI) and a visual analog scale (VAS). Differences between qualitative variables were determined using the chi-square test, whereas continuous variables were assessed using an unpaired *t*-test. Differences were considered to be statistically significant at $p \leq 0.05$.

Results: Patient satisfaction with PHE was significantly higher and differed in the Group E for two parameters: education method (80%), educational material (94%). For all parameters of procedural education, patient/clinician satisfaction was significantly higher for Group E [method (93%), material (85%), patient preparation (89%), personalized education (84%), program (93%)]. From three different ratings of disease education, 70% in Group E rated education as “effective” as compared to 41% in the Group C. Effectiveness of post treatment, education measured through DHI, revealed a lower hygiene score in Group E ($m = 1.18$) as compared to Group C ($m = 2.92$), with differences being significant. For treatment satisfaction, patients in Group E rated higher for speech ($m = 8.21$), ease of chewing ($m = 7.36$), and general satisfaction ($m = 7.9$).

Conclusion: This study concluded that using audio as a means of imparting PHE positively influences the treatment compliance and satisfaction among outpatients and overcomes the drawback of wearing mask during the pandemic.

Keywords: patient education, prosthodontics, treatment satisfaction, denture hygiene, multimedia, patient compliance

Introduction

An organized, well-planned, and systematic didactic activity is essential to impart effective patient health education (PHE) since patients generally lack an understanding of medical information, irrespective of their literacy status. The functional literacy of the

population has been reported to be low even in developed nations such as the United States.¹ Health education must achieve the goal of aiding the population in intentionally embracing a healthy lifestyle and behavior, thereby preventing disease and uplifting one's life value. Patient education varies across different settings (outpatients and inpatients); however, the principle purpose of helping patients regain normal health remains the same. Medical nurse, who comprise over 70% of the healthcare team, plays a significant role in patient education in medical outpatient department (OPD),² but their role in the dental OPD is conspicuously absent. PHE can be cumbersome, time-consuming, unpredictable, and futile despite efforts. PHE in geriatric Prosthodontic care (GPC) is endorsed as being initiated as early as the first visit and must continue sequentially during subsequent procedural and treatment visits.³ The purpose of PHE in GPC generally includes exploring patient expectations, improving mental attitudes, instilling preventive practices, and seeking consistent maintenance care.⁴ PHE information is magnanimous, multidimensional, and multidirectional; therefore, the information must be presented in a form that is acceptable to the patient. Educational materials have been formatted in various ways to achieve patient compliance.⁵ Patients tend to forget more than half of treatment-related information, which has led to some new patient strategies in the form of simulated games, interactive videos, and role-playing.⁶

Characteristically, key prosthodontic outpatients are geriatric patients who develop weakened senses (eyes and hearing) and become senile with aging. Our dental hospital OPD, on average, interests 500–700 patients daily and has restricted allied healthcare workers. The continued presence of the COVID –19 pandemic has created new challenges in interpersonal communication that still need to be countered successfully. Wearing masks and social distancing impair speech intelligibility by gagging sound and eradicating facial expressions (nonverbal communication),⁷ which aggravates patients' anxiety.⁸ With this background, we proposed and designed an experimental audio didactic archive for dental outpatients and used it to supply general and treatment-specific information in the Department of Prosthodontics. To the best of our knowledge, audio education has been limited to, hospital inpatients and has not been investigated among outpatients. There are distinct differences between the two hospital settings. This study aimed to (a) evaluate the probability of employing an audio-based PHE intervention for outpatients in the prosthodontic department, (b) assess the influence of such interventions on various dimensions of health education, (c) evaluate patient and clinician satisfaction with such interventions, and (d) examine their influence on treatment outcome (denture/tissue hygiene) and treatment satisfaction.

Materials and Methods

Ethics Approval and Consent to Participate

This research and its respective procedures were approved by the Institutional Review Board (IRB) and University Ethics Committee of Swami Vivekananda Subharti University (vide approval number: SVSUSDC-E0000234-D). Any research conducted in the university that involves humans, complies with the standards/principles/ethical guidelines of the Declaration of Helsinki of 1964. All the participants provided written informed consent for participation in the study and/or publishing its results.

Study Design

This PHE program was conducted between the first quarter of 2020 and the first quarter of the following year. The study was conducted at a postgraduate institute in North India in accordance with the standards and requirements of its affiliated university. This clinical study utilized experimental approach, the setting of which was an open field. The study was based on an informal experimental design that used audio education as an intervention for PHE.

Preparing, Categorizing and Converting PHE Material

The PHE material to be included in the program was reviewed and discussed (focus group discussion), covering five PHE categories, as detailed in Table 1. The entire content of the program was translated/back-translated to accommodate a wide array of local language-speaking patients (English, Hindi, and Urdu), following which they were recorded as audio files (Canopus EDIUS – 5 Pro version). A table of content was provided at the beginning of the audio, which allowed direct access to a particular content/topic/category rapidly and accurately. The total duration of all audio files (admission: 5 min 20s, examination education: 2 min 40s, procedural education (3 min 50s), disease education (average of 3 min), and post-insertion education (4 min 20s) was 19 min 10s.

Table I Didactic Patient Health Education Archive

S.no	
1.	Registration/admission education: (Timing – first day): Introducing patient to the department environment/schedule, rules and regulations (general and Covid 19 specific), facilities and grievances, understand OPD process and its organizational component (medical, dental assistants/ technicians, ancillary staff, administrative staff), prosthesis fabrication cycle, synchronized clinical and laboratory steps, appointment scheduling/rescheduling, outpatient clinics discipline regarding strict compliance to patient safety, infection control measures, arrival time (early, on-time, late), everyday checklist before departing.
2.	Examination education: (Timing – first two appointments) Sphygmomanometer, diabetes testing kit, blood analysis, computed tomography, orthopantomogram, cone beam computed tomography, magnetic resonance imaging, histopathology, pulp vitality test, occlusal scan.
3.	Procedural education: (Timing – before every clinical procedure and at patients request) Importance of revealing full medical information (Covid specific), understanding signs and symptoms of a disease including Covid 19 disease, use of different dental materials and their effects, limitations of materials, significance of practicing functional exercises at home, preparing for different procedures, checking notes provided by clinicians, various mandibular and tongue exercises.
4.	Disease education: (Timing – after definitive diagnosis) Denture stomatitis, traumatic ulcer, residual ridge resorption, angular cheilitis, denture irritation hyperplasia, flabby ridges, premalignant and malignant lesions and hypersensitivity and lichenoid reactions.
5.	Post insertion education: (Timing – on denture delivery) Speech: altered due to bulk, avoiding rapid conversation, avoid pronouncing same words repeatedly, maintaining standard speech pattern. Mastication: eating skills with different types and consistencies of food, soft or crispy food, avoid sticky food, take small bites, chew thoroughly, change eating pattern (bilateral food placement), avoid horizontal strokes, avoid social eating. Tissue/denture hygiene: avoid continuous wearing (8 to 10 hours in two periods), no wearing during sleep, finger massage of oral tissues, brush tongue and dentures as demonstrated, take essential nutrients, no alcohol/smoke/pan, use soft brush and simple tepid water for cleaning, clean after every meal, denture cleanser once a day, store dentures in water changed daily. Follow up protocol: schedule, importance and procedures.
6.	Personalized education: (Timing – customized/individualized) Enquiries, doubts and/or clarifications that patients required regarding any part of the education program was explained in face to face contact, or sent through an SMS, email or a secured patient portal of the university.

Note: P/N: Different types of patient education along with their respective timing, duration, contents and parameters covered during the program.

Sample Preparation, Selection and Grouping

Patients were screened for dementia (Mini-Mental State Examination [MMSE]) and cognitive impairment (Elderly Cognitive Assessment Questionnaire [ECAQ]) prior to the selection of candidates for the PHE program. Patients with mental alterations, deafness, extremely old age (≥ 90 years), indifferent mental attitudes, depression, and suffering from self/elder neglect were excluded. Patients who were older denture wearers (≥ 3 years) with denture-related diseases/conditions, willing to fabricate new dentures, had access to audio players/mobile phones, were able to read the instructions, and had no chronic systemic disorders were included in the study. The characteristics of the study participants and those of their associated diseases (denture stomatitis) are presented in Table 2. The distribution of patients in each group was performed using simple random sampling, whereas the sample design for both groups was convenient (consecutive) sampling. Various steps were taken to minimize the influence of confounding variables on the study outcome. These included random allocation of subjects in each group, restriction (strict adherence to inclusion and exclusion criteria) and matching the subjects through homogenization (statistical) of two groups (Table 2A and B). All of the patients in this program were treated by postgraduate students under the direct supervision of experienced staff. The patients in the experimental group (Group E) were provided with a personal copy of the MP3 audio file (MPEG-1 Audio Layer 3) on the first day of outpatient registration, where they were given an appropriate appointment. Patients were instructed to listen to the audio file carefully during the course of their respective treatments and to clear their doubts in subsequent visits. Patients in the control group (Group C) were educated using traditional methods (oral/verbal with written instructions in a pamphlet). All patient queries were simplified during face-to-face conversations (personalized education).

Table 2 (a) Demographic Characteristics of the Study Participants. (b) Characteristics of Patients with Denture Stomatitis

A			
	Control group	Experimental audio group	Tests for significance
Number of patients	324	342	N.A
Gender (male/ female)	210/114	203/139	^a $\chi^2 = 2.104$, P = 0.1469 (NS)
Age (years) (M $\pm$ SD)	68 $\pm$ 14.12	71 $\pm$ 16.23	^b T= 0.32913, P= 0.37292 (NS)
Main problem (associated disease)			
Denture Stomatitis	96	88	^a $\chi^2 = 1.8493$, P = 0.7634 (NS)
Traumatic Ulcer	80	79	
Residual Ridge Resorption	62	73	
Premalignant Lesions	25	29	
Denture Irritation Hyperplasia	22	27	
Angular Cheilitis	20	23	
Flabby Ridges	19	23	
B			
Number	96	88	N.A
Gender (M/F)	57/39	53/35	^a $\chi^2 = 0.0139$, P = 0.9062 (NS)
Age (years) (M $\pm$ SD)	68 $\pm$ 12.12	70 $\pm$ 14.28	^b T= 1.4433, P= 0.09392 (NS)
Associated with candidiasis	23	20	^a $\chi^2 = 0.0389$, P = 0.8437 (NS)
Not associated with candidiasis	73	68	

Notes: ^a Chi square test (to examine the differences between categorical variables in the same population, categorical data). ^b Independent *t* test (to examine differences in means between two groups). Levels of significance: NS (not-significant) = $P \geq 0.05$; Significant = $P < 0.05$.

Abbreviations: N.A, not applicable; M, Mean; SD, standard deviation.

Measures, Data Evaluation, Collection and Analysis

Data for the health education program were collected using: 1) A reliable questionnaire [original reliability (0.792); standardized reliability (0.822) and the KMO (Kaiser-Meyer-Olkin) sampling adequacy, value of 0.8 (variation 85.133%)]. 2) A 10-point questionnaire for knowledge feedback rate of efficiency of imparting disease education ($\geq 50\%$ effective, between 20 to 50% basically effective, $\leq 20\%$ ineffective).⁵ 3) Denture hygiene index (DHI) objectively evaluated the effectiveness of the maintenance of tissue/denture hygiene.⁹ 4) Treatment satisfaction of patients was measured using a ten-point visual analog scale (VAS), which presents a list of random questions with reversed polarity.⁹ Collected data were entered into the Statistical Package of Social Sciences (SPSS 25.0) (IBM, Armonk, New York, US) software. Frequency distribution and mean values with standard deviations were defined as continuous and qualitative variables, respectively. Tests for significance and their respective levels of significance included the chi-square test [questionnaire survey, knowledge feedback] and unpaired *t*-test [denture hygiene index and treatment satisfaction]. Differences were considered statistically significant when the probability value (p-value) was less than 0.05.

Results

The time required for each type of education varied among categories and groups. The demographic characteristics of the study participants and patients with denture stomatitis are shown in [Tables 3A](#) and [B](#), respectively. No significant differences

Table 3 (a) Patient/Clinicians Satisfaction with Health Education Program Based on Questionnaire Survey Done at the Time of Treatment Completion (n=666). (b) Clinicians Satisfaction with Procedural Education Done in Advance of a Clinical Procedure. (c) Knowledge Feedback Rate for Disease Education in Denture Stomatitis Patients

A				
	Control group (n=324)	Experimental group (n=342)	χ^2	p
	Yes (%)	Yes (%)		
Satisfaction with current education method?	201 (62.03)	277 (80.99)	20.13	0*
Education material meeting patient's needs (convenient, accessibility)?	203 (62.65)	324 (94.73)	112.88	0*
Did clinicians (postgraduate students) conduct timely health education?	300 (92.59)	319 (93.27)	0.05	0.8
Did clinicians clarified the enquiries you had (personalized education)	290 (89.50)	301 (88.01)	2.27	0.128
Were you satisfied with the clinicians in general	298 (91.97)	331 (96.78)	1.08	0.345
B				
Satisfaction with current education method?	182 (56.17)	320 (93.56)	18.87	0*
Education material meeting clinicians needs?	178 (54.93)	291 (85.08)	20.08	0*
Satisfaction with patients preparation for procedural education?	78 (24.07)	307 (89.76)	56.34	0*
Satisfied with clarifying patients queries (personalized)	170 (52.46)	290 (84.79)	48.78	0*
Were you satisfied with the education program in general?	180 (55.55)	321 (93.65)	23.68	0.0*
C				
	Control group (n=96)(n%)	Experimental group (n=88)	Z	p
Effective	40 (41.67)	62 (70.45)	-3.67	0.001*
Basically effective	31 (32.30)	18 (20.45)		
Ineffective	25 (26.04)	8 (9.09)		

Notes: *Significant - Level of the degree of significance was determined on the value of $p < 0.05$. Tests of significance determined by chi square test. Knowledge feedback scores: ($\geq 50\%$ effective, between 20 to 50% basically effective, $\leq 20\%$ ineffective).

were found in age, association with candidiasis, or duration of PHE between the two groups. On average, the duration of the question and answer session was higher in Group C (7.4 ± 0.70 min) than in Group E (2.8 ± 0.79 min). The questionnaires distributed among patients in both groups and the clinicians who treated them had a zero dropout rate. Satisfaction rates of patients between two groups regarding education method (Tables 3A) were significantly higher in the Group E (80.99 vs 62.03%). Higher frequency of Group E patients found the educational material extremely convenient and easy to access (94.7 vs 62.5%), with differences between the two groups being statistically significant ($p \leq 0.05$). The clinician's satisfaction rates, with the patients belonging to the Group E was also significantly higher than patients in the Group C for education method (93.56 vs 56.17%), education material (85.08 vs 54.93), patient preparation (89.76 vs 24.07%), personalized PHE (84.79 vs 52.46%) and overall education program (93.65 vs 55.55%). Knowledge attainment in disease education was found higher in the Group E [effective (70.45 vs 41.67%); basically effective (20.45 vs 32.30%); ineffective (9.09 vs 26.04%)]. The differences between the two groups were statistically significant ($P < 0.05$) (Tables 3C). There was a higher percentage of

Table 4 Comparative Differences in Means for Various Post Insertion Education Parameters Between Studied Groups

Parameters		Control Group (n=96)			Experimental Audio Group (n=88)			P value
Denture hygiene index (at 1 month)	Scores	N (%)	Mean ± SD	SEM	N (%)	Mean ± SD	SEM	0.0000*
	Good	12 (12.5%)	2.92±0.892	0.1564	52 (59.09%)	1.18 ± 0.618	0.1084	
	Average	33 (34.37%)			21 (27.27%)			
	Poor	27 (28.12%)			12 (13.63%)			
	Very Poor	24 (25%)			3 (3.40%)			
Speech			5.0 ± 1.118	0.1961		8.21 ± 0.780	0.1961	0.0000*
Ease of chewing			4.72 ± 1.125	0.1973		7.36 ± 0.895	0.1973	0.0000*
General satisfaction			5.03 ± 1.103	0.1935		7.90 ± 0.630	0.1935	0.0000*

Notes: Scoring criteria: 0 – no denture plaque, 1 – light plaque (25% present), 2 – moderate plaque (26–50% covered), 3 – heavy plaque (51 –75% covered), 4 – very heavy plaque (76% or more covered). *Significant - Level of the degree of significance was determined on the value of $p < 0.05$. Tests for significance determined using unpaired “t” test.

patients who scored a rating of “good” for tissue hygiene (59.09 vs 12.5%) in the Group E (Tables 4). The mean scores for denture plaque were lower in Group E (1.18 – light plaque) than in Group C (2.92 – moderate plaque), indicating better compliance with post-insertion instructions by patients in Group E. For treatment satisfaction, the mean VAS scores were higher among patients in Group E, with differences between the two groups for all three parameters being statistically significant ($p \leq 0.05$).

Discussion

This experimental study was impelled by the negative impact of wearing mouth/face masks on interpersonal communication in a prosthodontic setup, in which PHE and motivation are key factors for treatment success. The results of this study showed that the audio format for delivering PHE was more satisfactory for outpatients and their respective clinicians. Another key finding was that the audio-mediated education enhances personalized education, as repeated listening clarifies simplicity through complex instructions. On average, the question and answer sessions were higher in Group C (7.4 $\pm$ 0.70 min) than in Group E (2.8 $\pm$ 0.79 min). The patients’ health education included five different education categories from admission to discharge. The use of audio-mediated patient education has been limited to inpatients,⁵ and has never been explored among outpatients or those receiving prosthodontic care. Structural differences between medical and dental care include a higher percentage (80%) of medical specialists delivering medical care, and higher categories of allied medical personnel in the medical field.¹⁰ PHE in gerodontic care has traditionally been ignored, and physiologically and structurally correct prostheses have been unsuccessful, due to less emphasis placed on patient education.¹¹ Poor PHE has been associated with poor treatment compliance, especially in chronic diseases that require lifestyle changes.¹²

The results of our study regarding the educational method and audio material are in agreement with those of a study conducted on inpatients.⁵ The rest of the parameters for patient satisfaction with health education were not significantly different, as in the present study. We introduced procedural education that is highly relevant to prosthodontics and includes detailed educational material to prepare patient for a particular clinical procedure (mandibular, tongue, or head movement). Patients are usually demonstrated chairside; however, with restrictions on mouth masks, these demonstrations are risky. Our results showed that for all parameters of clinician satisfaction, the differences between the two groups were significant. Patients in Group E responded better to the clinician’s commands during the treatment procedure. The reason for the better response could be lower anxiety levels among those who were well versed with what was required during the treatment procedure. Anxiety related to dental procedures has been found to be high (92%),¹³ and needs to be addressed to avoid their ill effects.¹⁴ A patient who has forgotten what he or she is asked to do at home will have higher anxiety levels that affect his or her performance during clinical procedures.

The results showed that the audio format improved the outpatients' knowledge of their disease. A higher frequency of patients in the Group E graded PHE program "effective" (70%) as compared to Group C (41%). Denture stomatitis is a denture-related disease that is behavioral in nature. Audio files provide immediate and desirable access to the instructions and/or responsibilities expected by the patient. Elderly patients, whose motivations are variable, can benefit more from immediate access to the desired patient education. Denture stomatitis can present with varying degrees. Although the disease is resolved through a medication regimen, the preventive aspects are completely associated with modifying one's behavior and attitude towards wearing prostheses. During the study, it was observed that patients in Group E acquired more information about disease prognosis, disease outcome, and treatment options. Similar findings were reported by Amundsen et al, who provided cancer patients with an audio recording of patient consultations as a communication aid.¹⁵ Audio recording of PHE has also been reported to be associated with patients' ability to recall 61% of the total information among outpatients.¹⁶ This suggests that repeated listening improves the patients' ability to memorize the information given to them. The quantity of information and increased age of the individual (≥ 70 years) have been found to be inversely related to the patients' ability to recall medical information.¹²

Our study found a significant difference in patient compliance with denture/tissue maintenance and treatment satisfaction between the two groups. Audio education has been studied and is known to improve treatment compliance in various diseases.^{17,18} The audio format of the PHE material prepared for this study was organized and systematically arranged according to the contents. A single continuous track without content is cumbersome for repeated accesses. The design of an audio tool must be customized according to the target population. Every population presents barriers, ranging from language proficiency to the accessibility of digital tools.^{19,20} The audio being easily accessible fortifies patient learning and allows patients to identify their weaknesses during the learning of the skill. Regarding denture hygiene, our results agree with those of an earlier study of visually impaired patients who showed improved hygiene scores for natural teeth using audio aids.²¹ The skill of eating and speaking with new dentures is instrumental in affecting quick and competent treatment satisfaction among older edentulous patients. Even if a patient is an old denture wearer, the use of new dentures is challenging in the first few weeks, particularly if the tissues have recovered from an unhealthy state. The patients in Group C took longer time to heal from their existing mucosal pathology than those in Group E and scored low on VAS for treatment satisfaction, phonetics, and mastication.

PHE significantly contributes to treatment success, for which relatively high levels of motivation are required among healthcare workers. According to one estimate, a single dollar spent on PHE saves three or four times healthcare costs.²² However, a high-quality PHE requires proper resources.²³ In countries such as India, the use of audio formats for patient health education is a viable alternative. The end of the pandemic is in no sight, as many children have not yet received their first vaccination, suggesting that we may still have time to spend performing interpersonal communication with mouth/face masks. The use of mobile applications (secondEars) that allow patients to consult audio records has been reported in oncology, but raises legal issues.²⁴

This study presents a simple, effective, and economical method of interpersonal communication that is not limited to prosthodontic care. The study also highlights the various types of education that patients should be provided in an OPD. This study was limited by the results being derived from a small sample size and the presence of only one denture-related disease. The limitations of the study design (cross-sectional) and specific age group (40 to 70 years only) also need to be considered.

Conclusion

Within the limitations of this study, it can be concluded that auditory media can be used to improve the effectiveness of PHE in the prosthodontic OPD. It also overcomes the effect of those variables that affect minimum common learning in older patients. The negative impact of using a mouth mask on interpersonal communication can also be curtailed as such an approach is practical and economically viable compared to multimedia.

Use of audio as a PHE tool was also found to influence various dimensions of health education related to denture and tissue abuse, thereby preventing the occurrence of diseases like candidiasis. Patients and clinicians both were highly satisfied with the intervention, however the long term effects of such intervention needs to be further studied. Treatment outcome and treatment satisfaction was found to be better in the intervention group than in the control group, thus audio

mediated education should be used in geriatric Prosthodontic care to deliver patient health education and patient-centered care. Given the limited resources of most academic institutes in developing countries, such as India, audio education is an economic tool to fill the gap caused by the deficiency of human and economic resources.

Data Sharing Statement

The data generated in the present study are included in the figures and/or tables of this article.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare that they have no competing interests during conductance or publishing the results of this study.

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