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Comparative Evaluation of Verbal, Printed, and Virtual Reality Approaches for Post-Operative Dental Care Instructions: Perspectives of Patients and Dental Students

Sajda Khan Gajdhar[1], Ramandeep Bawa[2], Niharika Benjamin[3], Smita Durga Dutta[4], Pankaj Kukreja[5], Amrit Podder[6] and Anukriti Kumari[7]

[1]Division of Oral Pathology and Microbiology, Department of Oral Basic and Clinical Sciences, Ibn Sina National College for Medical Studies, Jeddah, Saudi Arabia
[2]University Institute of Fashion Technology and Vocational Development, Panjab University, Chandigarh, India
[3]Government Dental College and Hospital, Jamnagar, Gujarat, India
[4]Department of Conservative Dental Sciences and Endodontics, College of Dentistry, Qassim University, Saudi Arabia
[5]Department of Biomedical Dental Sciences, Faculty of Dentistry, Al-Baha University, Al-Aqiq Campus, Al-Baha, Kingdom of Saudi Arabia
[6]Department of Physiology, Teerthanker Mahaveer Medical College & Research Centre, Teerthanker Mahaveer University, Moradabad, Uttar Pradesh, India
[7]Department of Oral Medicine and Radiology, School of Dental Sciences, Sharda University, Greater Noida, Uttar Pradesh, India

Author Designation: [2,3,6]Assistant professor, [4]Associate Professor, [5]Professor, [7]Practitioner

*Corresponding author: Niharika Benjamin (e-mail: niharika.benjamin0@gmail.com).

Abstract **Background:** Effective post-procedural management in dentistry is essential for optimal healing and prevention of complications. The mode of delivering post-procedural instructions influences both patient comprehension and compliance, as well as dental students' learning and confidence. **Objective:** This study aimed to compare the effectiveness of verbal communication, printed handouts, and virtual reality (VR)/Metaverse-based instructions in delivering post-operative care information to patients and dental students. **Methods:** A cross-sectional survey was conducted among 279 patients (150 males, 129 females) who underwent dental procedures and 100 dental students at different stages of training. Two structured questionnaires assessed comprehension, accessibility, confidence, and preference. Chi-square tests were applied to evaluate associations between instruction method and participant responses. **Results:** A majority of patients preferred verbal instructions for comprehension (55.2%) and confidence (51.9%), whereas VR was considered more systematic by a subset (21.5%). Among students, verbal instruction was valued for communication skills (46%), but VR/Metaverse was rated highest for accessibility (38%) and completeness (55%). Chi-square analysis showed no significant association between instruction method and patient preferences ($p = 0.18$), but a significant association was observed among students ($p < 0.001$). **Conclusion:** Verbal communication remains central to patient education due to its reassurance and trust-building value, whereas immersive technologies such as VR/Metaverse offer distinct advantages in accessibility and thoroughness for dental students. A hybrid approach combining traditional and digital methods may optimize post-operative care delivery and education.

Key Words Dental Education, Post-Operative Care, Patient Communication, Virtual Reality, Instructional Methods

INTRODUCTION

Proper post-procedural care is a crucial lifeline in the field of dentistry, ensuring optimal recovery and reducing the risk of post-surgical complications. Removal of a tooth is a routine dental procedure. After proper observance of specific aftercare measures, the patient can avoid infection, minimize pain, and facilitate the healing process [1]. The way post-procedural instructions are presented significantly impacts how well patients understand and adhere to them [2]. Moreover, proposals regarding the management of dental students' post-treatment procedures also influence their course orientation and practice [3].

The research examines the effectiveness of various methods for providing post-procedural care instructions to both dental students and patients, with an emphasis on communication techniques, the use of teaching aids, and the resulting outcomes [4]. Good aftercare reduces the risk of complications such as tooth loss, contraction, dry socket, haemorrhage, and swelling. A good application of these rules shortens the healing time and minimizes the risk of complications [5].

On the contrary, poor communication during aftercare can result in misunderstanding, treatment defaults, and even an increase in postoperative issues. In this regard, it becomes crucial to explore optimal avenues for delivering these directions to the patient, along with dental students [6].

Conventionally, the use of oral means of communication, supplemented with written materials in the form of handouts or booklets, has been identified as an effective method for administering post-extraction therapy to dental patients [7]. Nevertheless, research has revealed that voice instructions alone are not guaranteed to ensure patients' compliance and comprehension. Adding written or graphical content may make the work clearer and more effective. Digital technologies are spreading, driven by modern technical innovations, and offering valuable guidance on post-extraction treatment. The features of these technologies attract great attention, as they prove to be rather simple and accessible, allowing them to incorporate interactive webpages, mobile applications, and video courses. Digital media with high levels of tailoring and interactivity have large potential in patient education and adherence to post-extraction care processes [8]. Reminders, as well as progress updates on the recovery issue, can be provided using digital tools and smartphone applications to minimize the potential for problems.

In addition to the issues they create in patients' lives, these digital solutions have significant effects in various aspects. The guidance on how patients are to be handled after a dental replacement process is proving to be essential to dental students as time progresses in the field of dental education [9]. In addition to learning the technical aspects of post-operative treatment, dental students should acquire the skills necessary to present such recommendations effectively, not only professionally and sympathetically, but also successfully [10,11]. Although more traditional approaches to teaching might allow the use of role-playing tasks or written assignments, more modern strategies have already been introduced, referencing items such as digital platforms, multimedia tools, and simulation software [12]. It has been found that experiential learning using technology, such as VR, AR, and the Metaverse, is becoming increasingly effective in developing effective communication skills. These students will also be able to read about the post-extraction care, train their skills in such situations, and read the comments left by their classmates and lecturers [13].

The proposed study aims to determine the effectiveness of various methods in providing clear and appropriate recommendations for post-procedural care in clinical practice and at the dental school [14]. This study will be conducted by using a point of view analysis of the perspectives of both patients and the dental students in which both sides of this experience are analysed in order to determine the best way of ensuring the maximizing of patient outcomes that in turn provide a better teaching environment for the dental students [15]. The curriculum will blend traditional courses, such as spoken and written handouts, with more contemporary courses, including virtual reality (VR) and the Metaverse. Besides different delivery models, the study will also focus on aspects such as patient demographics, literacy levels, and technical skills [16,17,18]. Through data collection, patients are given the opportunity to express their various needs and desires. The same applies to dental learners, who may be more or less experienced in operating various communication tools; therefore, knowledge of these differences will enable the adjustment of teaching strategies to address individual needs [19].

METHODS

Study Design

A comparative cross-sectional survey was conducted among two groups: patients receiving dental treatment and dental students in training.

Participants

The study included 279 patients (150 males, 129 females) who had recently undergone various dental procedures (including extractions, minor surgical interventions, and restorative procedures) and 100 dental students at different academic levels. Inclusion criteria were willingness to participate and ability to provide informed consent.

Instruments

Two validated questionnaires (one for patients, one for students) were developed. Each used a 5-point Likert scale to assess comprehension, accessibility, completeness, confidence, and preference. Demographic information (age, gender, education level) was collected.

Interventions

Three instructional modes were compared:

- Verbal communication by the clinician,
- Printed handouts containing stepwise instructions,
- Virtual reality (VR)/Metaverse modules simulating post-operative care scenarios.

Data Collection

Patients completed questionnaires after receiving instructions post-procedure. Students completed questionnaires during scheduled teaching sessions. Surveys were provided in both digital and paper form.

Statistical Analysis

Data were analysed using descriptive statistics (frequency, percentages, mean ± SD) and Chi-square tests to examine associations between instructional methods and responses. Statistical significance was set at $p < 0.05$.

Questionnaire:

Questionnaire was divided into two parts for accuracy, different for two types of respondents. To maintain the quality of the research finding, students were also included along with patients, both questionnaires are shown in Table 1 and 2.

Table 1: Patient Questionnaire

No.	Question	Options
1	I feel emotionally reassured when post-procedure instructions are given verbally by the dentist.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
2	I can easily remember the steps explained to me using printed instructions.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
3	My caregiver or elderly family members would likely understand the post-op instructions better if they were explained verbally.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
4	I find it convenient to revisit the instructions using virtual reality or metaverse tools.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
5	Verbal instructions made me confident in managing my recovery at home.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
6	The virtual reality/metaverse session felt respectful and easy to engage with.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
7	Printed instructions covered all essential steps of post-dental care.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
8	I trust that no important steps were missed during the VR/Metaverse session.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
9	The VR/Metaverse experience was too long for my comfort.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
10	I would prefer verbal instructions over other formats for post-dental care.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
11	I trust my dentist more when they provide the post-care steps face-to-face.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
12	Virtual tools made it easier to accurately recall post-operative instructions.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
13	I feel better cared for when instructions are explained verbally and personally.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree

Table 2: Student Questionnaire

No.	Question	Options
1	Verbal instruction is the most effective method for training patients on post-treatment care.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
2	Paper handouts make follow-up easier and ensure consistency.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
3	I feel confident explaining post-care steps using virtual reality and the metaverse.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
4	VR/Metaverse tools ensure more complete and detailed patient instructions.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
5	I can access VR-based materials more easily than verbal or written instructions.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
6	Verbal communication prepares me better for handling patient questions.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
7	Written instructions prevent missing any important post-care advice.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
8	VR simulations helped me develop better communication skills.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
9	The time spent on VR/Metaverse sessions feels excessive.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
10	VR/Metaverse enhanced my understanding of time and empathy in patient education.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree
11	I would recommend incorporating VR/Metaverse tools into every dental training program.	a. Strongly Disagree, b. Disagree, c. Neutral, d. Agree, e. Strongly Agree

Table 3: Patient Questionnaire - Results

Aspect	Verbal Instructions	VR/Metaverse	Paper Instructions
Preferred Method for Understanding Post-Operative Care	154 (55.20%)	60 (21.51%)	65 (23.29%)
Preferred Method for Convenience & Accessibility	142 (50.90%)	68 (24.37%)	69 (24.73%)
Preferred Method for Elderly Patients & Caregivers	180 (64.51%)	48 (17.20%)	51 (18.28%)
Preferred Method for Increasing Confidence	145 (51.97%)	70 (25.09%)	64 (22.94%)
Most Trusted Method for Post-Extraction Instructions	135 (48.39%)	75 (26.88%)	69 (24.73%)
Preferred Method Recommended to the Doctor	165 (59.14%)	65 (23.30%)	49 (17.56%)
Method with the Most Advantages	118 (42.29%)	90 (32.26%)	71 (25.45%)
Don't Miss Any Instructions	120 (43.01%)	92 (32.97%)	67 (24.01%)
Most Convenient Instruction Format	110 (39.43%)	88 (31.54%)	81 (29.03%)

RESULTS

Patients

Verbal instructions were the most preferred method for comprehension (55.2%), accessibility (50.9%), and confidence (51.9%). Printed materials were chosen by 23.3%-29.0%, while VR/Metaverse was favoured by 21.5%-31.5% depending on the parameter (Table 3, Figure 1).

Students

While 46% preferred verbal instructions for confidence building, 38% rated VR as most accessible, and 55% considered VR to provide the most complete coverage of instructions. Printed materials were rated moderately across most domains (24-35%) (Table 4).

Statistical Analysis

For patients, no significant association was observed between instruction method and preferences ($\chi^2 = 20.5$, $p = 0.18$). For students, a significant association was found ($\chi^2 = 78.2$, $p < 0.001$).

Student Questionnaire

Post-Operative Instructions: The percentage of students who believed that verbal instructions would most suitably provide post-op care was 46 (46.00%), followed by paper (24, 29.27%), and VR (20, 24.39%). This implies that students would use conventional procedures for communicating with patients. Convenience of use: The highest number of students, 38 (38.00%), assigned the highest score (most accessible) to VR, followed by 35 (35.00%) to paper and 27 (27.00%) to verbal. This shows a transition of student demand toward the tech-powered, Just-in-Time content, particularly in resumes and re-studying.

Confidence Boosting

Once again, verbal instructions were the most popular, with 46 (46.00%) of the students contributing to improved confidence through their usage, followed by 30 (30.00%) students who preferred paper, and 24 (24.00%) students who used VR. This suggests that face-to-face, oral communication remains a valuable

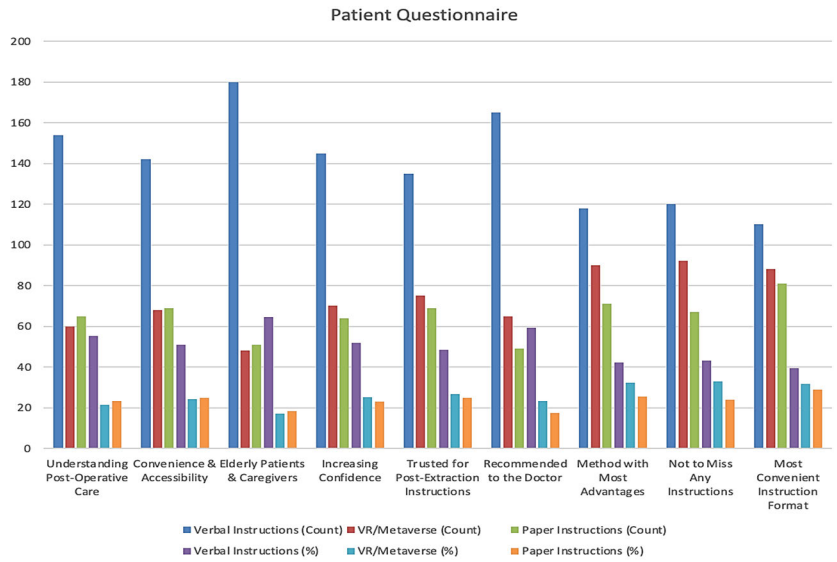

Figure 1: Patient questionnaire results

Table 4: Patient Questionnaire - Results

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tool for enhancing clinical confidence. How to Educate Patients: A total of 43 (43.00%) respondents opined that verbal communication is the most effective method of educating patients, 27 (32.93%) opted to use VR, and 20 (24.39%) would use paper. This implies that students appreciate the importance of tone, empathy, and flexibility in teaching.

Setting of Instructions

The dominant response in this regard was VR, where 45 students (54.88%) indicated that it covered all the main points, as opposed to 33 (33.00%) students who chose paper, and only 12 (12.00%) students chose verbal. It proves the fact that digital methods are evaluated as more systematic and thorough. In enhancing their communication skills, most students (57, or 69.51 percent) indicated that verbal methods helped them the most, whereas 19 (23.17 percent) mentioned VR, and only 5 (6.10 percent) spoke about paper. This further affirms the belief that face-to-face communication cannot be eliminated in the training of dentists.

The Chi-Square Test of Independence was conducted to assess the existence of a significant association between the method of instruction (verbal types of instructions, paper instructions, and virtual reality/Metaverse) and various variables from the patient and student questionnaires.

According to the patient questionnaire, the calculated chi-squared statistic from the test was approximately 20.50, and the p-value was around 0.18, which is larger than the predetermined significant value level of 0.05. Consequently, this indicates that we cannot reject the null hypothesis, meaning that there is no significant relationship between the method of instruction and patients' attitudes toward aspects of post-operative care.

On the contrary, the chi-squared statistic and the p-value of the student questionnaire are, respectively, 78.20 and 0.000000000001, indicating a very small p-value that is significantly below 0.05. This led to the rejection of the null hypothesis, suggesting that a significant correlation exists between the type of teaching and students' preferences for the choice of post-operative administration and communication.

It is, therefore, concluded that, on the one hand, the instructional process does not seem to have much effect on patient preferences regarding this or that analysis; on the other hand, it has a strong impact on the perception and communication preferences of the student within the context of giving the post-operative care.

DISCUSSION

The results of this research reveal specific preferences and perceptions regarding the effectiveness of various approaches to providing instructions on post-procedural care to dental patients and students [20]. For patients, verbal instruction was consistently the most preferred approach in all dimensions, including comprehension, accessibility, and confidence building, as well as other

considerations, such as recommending the instructional modality to the doctor [21]. This correlates with the conventional dental process and implies that a personal touch and direct connection, formulated through the process of verbal communication, are still highly appreciated by patients. Despite modern technological alternatives, the effectiveness of verbal instructions in enhancing patient comprehension and confidence is well recognized [22]. The fact that the instruction method is not significantly associated with patient taste in the Chi-Square test could reveal that, even though patients stress their liking of the verbal instructions, it does not mean that the other methods are completely ineffective among patients, but rather that they are just less desirable [23].

Dental students, on the other hand, were more refined in their opinions, especially in terms of accessibility, as well as ensuring that no instructions were left behind [24]. Although verbal instructions were also vastly appreciated as a way of enhancing communication and increasing their confidence in terms of issue instruction, Virtual Reality/Metaverse experiences were admitted to be the simplest way of access and the most accurate one in terms of fully covering and issuing instructions. This implies that, at least technologically more skilled students, possibly also more progressive in terms of their educational strategies, can recognize the opportunity for immersive digital tools to deliver information in detail and consistently [25]. The strong relationship identified in the student questionnaire suggests that the mode of teaching has a significant impact on how students feel and what they believe they should do after receiving a procedure to enable the provision of post-procedural care [26]. Such a perception gap between the patient and the students highlights the importance of considering both sides when developing instructional strategies.

It is understandable because many students prefer the use of Virtual Reality/Metaverse due to its convenience and effectiveness, which correlates with the increasing efforts to apply high-tech digital technologies in dental education and provide them with interactive learning opportunities [27]. It is with the help of these immersive technologies that students can be ensured of an even more realistic perception of patient education scenarios, allowing them to learn more successfully. Nevertheless, the ambivalence of opinions about the duration of VR/Metaverse experiences that patients have signals that the technology has its positive sides, but its application should be carefully planned to prevent overloading patients [28].

Such knowledge about preferences is also enhanced by demographic analysis, which considers factors such as age, gender, and educational level. Although one cannot analyse this issue in detail, it is crucial to consider that factors such as literacy level and technological skills may influence the appropriateness of various instructional methods. As an example, older patients or patients with lower literacy can still get the most value out of being verbally instructed or taught by example, which is an area in which VR/Metaverse is the least applicable, but younger and more technologically confident people could use VR/Metaverse as a very entertaining means to practice [29].

The study ultimately proposes that a multifaceted approach to post-procedure care instructions is the ideal approach. Though, on the one hand, verbal communication is still the primary aspect when it comes to patient comfort and confidence, on the other hand, the inclusion of advanced digital technologies, such as Virtual Reality/Metaverse, will enhance accessibility, guarantee the provision of comprehensive information, and benefit dental student readiness and communication skills significantly [30]. In the future, more types of hybrid models could be implemented to provide the most effective outcomes of post-procedural care, tailored to the needs of individual patients, by integrating the advantages of older approaches and contemporary techniques [31,32].

The study highlights distinct differences between patients and dental students in their preferences for post-operative care instructions. Patients consistently valued verbal instructions for reassurance, comprehension, and trust, which aligns with previous evidence on the importance of direct communication in clinical care [20-22]. Although VR and printed materials provided additional benefits, these did not significantly influence overall patient preference.

In contrast, dental students showed a strong inclination toward VR/Metaverse for accessibility and completeness, suggesting that immersive technologies may enhance their training and preparedness to deliver consistent instructions [23-25]. This is consistent with emerging literature supporting simulation-based training in dental education [26-28].

However, reliance solely on VR may not be appropriate for patients, especially older individuals or those with limited digital literacy [29]. Therefore, a hybrid instructional strategy, combining empathetic verbal communication with digital reinforcement, appears most suitable for clinical practice and education [30-31].

CONCLUSIONS

Verbal instruction remains the cornerstone of patient education due to its emotional reassurance and trust-building qualities. However, VR/Metaverse technologies offer significant advantages for dental students by ensuring completeness and accessibility of information. A hybrid instructional model that integrates both traditional and digital approaches is recommended to optimize patient outcomes and enhance dental education.

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