Research Article

Assessing Knowledge, Attitudes, and Practices of Augmented Reality Technology in Dentistry: A Cross-Sectional Survey

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ABSTRACT

Introduction: Augmented Reality (AR) technology is increasingly recognized for its potential to enhance various aspects of dental practice, including treatment planning, patient education, and training. Despite this potential, the understanding of dental professionals' knowledge, attitudes, and practices regarding AR technology remains underexplored. The objective of this research is to examine the experience, perceived advantages, and real application of augmented reality (AR) Technologies of dental faculty and students.

Methodology: A sample of 132 dental students, some integrated into the workforce as part-time private dentists, and faculty members of a single dental school, completed a self-administered online survey. Knowledge and application of AR technology in dentistry, and Experience with AR practice, were the constructs of the study. An administered questionnaire, partially digital and partially paper and pencil, was divided into two parts: Knowledge Assessment and Practice Assessment. The survey results were analyzed using reference statistics.

Results: Knowledge Assessment respondents confirmed understanding Augmented Reality (AR) technology (69.7), and AR technology in dental training/education was recognized (65.9). 57.6% of the participants in the Practice Assessment declared absence of AR in their educational and/or professional practice, but an AR technology practice was wanted (67.4). The self-rated proficiencies that 44.47% of the respondents professed were in the range of self-score 3 in the application of AR (moderate). A small fraction (16.7) declared their AR application self-score was above the higher order.

Conclusion: It can be concluded from this work that AR technology in academic and practical dentistry is vastly underutilized, notwithstanding the high realization and appreciation for its application.

Keywords: Augmented Reality, Dentistry, Dental Education, Proficiency, Technology Integration, Treatment Planning.

BACKGROUND

Augmented Reality was conceptualised over four decades in the 1960s, with great luminaries and pioneers such as Ivan Sutherland developing concepts as simple as head-mounted displays to project graphics over the real-world environment [1]. However, this technology has not achieved much success. It spread among many people as the computing machinery at that time was not suitable for the purpose. Additionally, video graphics displays had various drawbacks during the development of this technology. Innovations such as new smartphones, higher-power processing, and even robust sensors during the late 20th and early 21st centuries also created new opportunities for AR to be presented to reality [3]. High demands for portable devices compatible with augmented reality, combined with the emergence of platforms for developing AR Software, have also contributed to the further distribution and use of AR in other industries, such as medical rehabilitation and dentistry [4].

As augmented reality provides tools for assessment, treatment planning, and patient education, it will be one of the brightest prospects for the near future of medicine [5]. Surgeons' performance can be improved, and the effectiveness and efficiency of the methodology can be heightened by superimposing accurate anatomy models of patients in the actual operating field through AR. It can create value in the learning cycle of medical students and healthcare workforce members to learn complex structures and develop practice procedures through visualisation techniques [6]. Using it to explain medical conditions and potential treatments more comprehensively and engagingly, AR can help raise patients' knowledge levels and adherence to well-defined treatment plans. AR will assist dentists in formulating their treatments and conveying detailed information to their patients about their illnesses [7]. Augmented reality (AR) provides advanced capabilities in developing blueprints for complex operational modalities. For instance, AR shows a patient how a dental implant appears, feels, and functions before it is inserted into their mouth, and continues to show these attributes.

AR combines the tangible reality and the virtual elements to create a seamless platform for interaction [9]. The equipment is among the most advanced to include laptops, tablets, and smart glasses mounted on heads which, together with a suite of sophisticated sensors, including a camera to allow for picture taking, an accelerometer for movement mapping, a gyroscope for balance, as well as depth sensors to determine how far an object is positioned, help to perform a multitude of

calculations in real time, allowing for a rapid determination of location and orientation [10]. The AR programs rely on these gadgets to produce graphics for a user-defined interface. The interface is an overlay of the real world and responds to user prompts, which include touch, tapping, and voice commands. To trigger augmented content, markers and object tags, which can be real-world objects or virtual signs on a screen, are essential [11]. Tracking technology is also critical, as it enables the AR system to recognize the position of surrounding objects, and thus allows for the seamless placement of virtual elements to the correct environment [12]. For these reasons, AR systems can create functioning virtual worlds integrating real objects, and for these purposes, AR provides facilities for advanced multi-dimensional virtual worlds that allow for augmented reality applications with real-world objects.

MATERIALS AND METHODS

Study Design

This cross-sectional investigation examined the study subjects' understanding, perceptions, and practices related to the integration of Augmented Reality (AR) Technology within the field of Dentistry. A survey instrument was constructed to ascertain the level of acquaintance that study subjects had concerning AR Technology, the comprehension of its relevance to the educational and clinical facets of Dentistry, and the level of AR technology application. The instrument incorporated a Knowledge Assessment and a Practices Assessment.

Participants

The research population consists of 132 subjects, comprising dental experts, dental students (undergraduate and postgraduate), and dental associates/private practitioners in dentistry. Practicing in dentistry or education in dentistry was required in order to participate. Individuals without any connection to the field of dentistry were excluded. Also, participation in the study was voluntary, and informed consent was acquired before their engagement in the study.

Data Collection

The distribution of the survey was configured to maximize accessibility by employing an online survey platform as well as traditional paper forms for in-person distribution. There were both closed-ended response questions as well as randomly-ordered items along a Likert scale. The Knowledge Assessment questions asked to what extent participants were familiar with and

understood the technology known as Augmented Reality (AR). In comparison, the Practice Assessment questions asked participants to detail their use of and experiences with AR in the context of dental practice or education.

The Practices Assessment specifically gathered data on:

1. Whether participants had used AR technology in their dental practice or education.
2. The frequency of AR technology use.
3. The likelihood of incorporating AR in future practice or education.

Participants' self-rated proficiency in using AR technology, based on a 5-point Likert scale (1 being not proficient and five being highly skilled).

Data Analysis

Descriptive statistics were used to analyze the collected survey data. Basic frequencies and percentages were provided as raw results. Additionally analyzed were correlations between varying degrees of knowledge, attitudes, and practices regarding augmented reality (AR) technologies were investigated.

Ethical Considerations

The participants' confidentiality and voluntary participation were handled following all the ethical considerations of the study. No characteristics that could identify the participants were retrieved, and all the information collected was purged of personal identification.

RESULTS

A total of 132 people took part in the analysis, comprising 68 males (52.3%) as well as 62 females (47.7%) and in relation to the positions, 22 respondents (16.7%) were professors, 72 respondents (54.5%) were dental students (either undergraduate or graduate), and 38 respondents (28.8%) were private practitioners. In relation to the distribution of ages, 58 respondents (43.9%) were in the two decades to 29 range, whereas 44 respondents (33.3%) were 30-39 years, 18 respondents (13.6%) were in the 40-49 range, and 12 respondents (9.1%) were aged 50 years and above.

Knowledge Assessment

Awareness of AR Technology: The data demonstrate that most of the participants (69.7%) acknowledged AR Technology. Of these participants, the majority (45.5%) acknowledged AR Technology, while a segment (24.2%) was strongly supportive. Very few participants (11.4%) were in a situation where (14%) had minimal exposure. For this reason, this prompted access to the significant number (18.9%) of participants who in the survey were

also classified as having a high-degree status of invisibility in the measure of partial isolation as an excellent database of the overall position on the artificial reality. The number of responses on this measure as undefined encourages a sense of moderated awareness, which in turn suggests the participants are prime candidates for receiving educational interventions directed at AR.

Understanding of AR in Treatment Planning: Of the participants, the majority (60.6%) understand the benefits derived from the augmented reality (AR) of treatment planning across the domain of dentistry. Of this group, a significant number, 41.7% and of these participants, 18.9% consider the value as supporting augmented reality (AR) in treatment planning. However, an important group of the total 22.7% were supposed to be neutral, and this may imply that the group needs to be considered of the participants as requiring potential experience or exposure to the applications of AR with respect to the structured treatment planning. This group comprised a small segment (16.7%), which did not minimally agree or had a conflicting position, suggesting a position that has a restricted understanding or lacks evidence of the value of augmented reality for treatment planning.

Ability to Explain AR's Role in Patient Education: The most significant number of sampled participants (65.1%) held a position of having the ability to explain the value of applications of augmented reality (AR) to patient education and the domain of dentistry. This was supported by a majority (42.4%) of participants as having the ability to explain augmented reality. A segment of 21.2% of participants grouped as neutral indicates value in this group, having participated. Of these participants, 13.6% expressed a limited understanding, which suggests that on the role of AR, education needs to be directed.

Familiarity with AR Hardware and Software: While a majority of respondents (63.6%) reported familiarity with AR application hardware and software for dentistry, 19.7% indicated a neutral position, and 16.7% reported a lack of familiarity. Although many respondents possess a working familiarity with AR technologies, a significant portion may require greater exposure or training on the specific technologies relevant to this discipline.

Knowledge of AR's Benefits in Dental Training: 65.9% of participants reported an awareness of the potential benefits of AR in training and education. With 39.4% of participants agreeing, and 26.5% strongly agreeing, there appears to be a high level of support for the application of AR in the enhancement of educational methods.

Nevertheless, 22.7% of respondents chose a neutral position, and 11.4% disagreed, indicating a need for further information or experiences demonstrating the educational applications of AR. [Table 1].

Table 1: Knowledge Assessment of the Participants

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am familiar with Augmented Reality (AR) technology.	5 (3.8%)	10 (7.6%)	25 (18.9%)	60 (45.5%)	32 (24.2%)
I understand how AR can enhance treatment planning in dentistry.	7 (5.3%)	15 (11.4%)	30 (22.7%)	55 (41.7%)	25 (18.9%)
I can explain how AR applications can improve patient education in dentistry.	6 (4.5%)	12 (9.1%)	28 (21.2%)	56 (42.4%)	30 (22.7%)

Table 2: Attitude Assessment of the Participants

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
I believe that AR can significantly enhance the learning experience in dental education.	5 (3.8%)	10 (7.6%)	25 (18.9%)	60 (45.5%)	32 (24.2%)
I feel confident in using AR technology for treatment planning and patient education.	7 (5.3%)	15 (11.4%)	30 (22.7%)	55 (41.7%)	25 (18.9%)
I think patients would be more engaged in their treatment plans if AR is used.	6 (4.5%)	12 (9.1%)	28 (21.2%)	56 (42.4%)	30 (22.7%)
I would recommend the use of AR technology to my colleagues in the dental field.	8 (6.1%)	14 (10.6%)	26 (19.7%)	54 (40.9%)	30 (22.7%)
I perceive AR technology as a valuable tool in modern dentistry.	5 (3.8%)	10 (7.6%)	30 (22.7%)	52 (39.4%)	35 (26.5%)

Table 3: Knowledge Assessment of the Participants

Statement	Yes	No	Daily	Weekly	Monthly	Rarely	Never	1 (Not Proficient)	2	3	4	5 (Highly Proficient)
Have you ever used AR technology in your dental practice or education?	45 (34.1%)	87 (65.9%)	-	-	-	-	-	-	-	-	-	
If so, how frequently do you utilize AR technology in your practice or education?	-	-	8 (17.8%)	12 (26.7%)	10 (22.2%)	15 (33.3%)	0 (0.0%)	-	-	-	-	
Do you think you will incorporate AR technology into your practice or education in the future?	75 (56.8%)	10 (7.6%)	-	-	-	-	-	-	-	-	-	
How would you rate your proficiency in using AR applications for dental purposes?	-	-	-	-	-	-	-	15 (11.4%)	20 (15.2%)	45 (34.1%)	32 (24.2%)	20 (15.2%)

Attitude Assessment

The vast majority of participants (69.7%) feel that AR can improve learning in the area of dentistry. A small percentage (11.4%) feel opposition to AR in education. The majority of participants 18.9% neutral response shows that not all participants have the same level of familiarity or understanding of it. Confidence in Utilizing AR for Educating and Treatment Design: A majority of participants, 60.6% showed confidence in the area of using AR to educate and design AR treatment. One-fifth of participants, 22.7% who were neutral, and 16.7% reported a lack of confidence, show that not all the participants fit within the confidence umbrella. A large portion of the participants require a higher level of exposure and understanding of AR as a technology. Patient Engagement: Of participants feel that AR would enhance patient engagement in AR treatment plans. A high level of patient interaction can be expected. 21.2%, neutral responses demonstrate that not all participants understand how AR can enhance patient engagement. A small portion of participants have a lack of confidence concerning the AR utilization in treatment engagement and interaction. Recommending AR to Other Colleagues: More than half of the participants, 62.6% would recommend AR technology to other dentists.

Nevertheless, 19.7% of the participants provided neutral responses, whilst 16.7% of participants were in the opposing camp, suggesting that although there is growing support for this position, further support is still warranted and may be more readily provided with training and/or success demonstrations. Perception of AR as a Valuable Tool. The perception that AR is a valuable tool within modern dentistry was one that was strongly held with 65.9% of the respondents in agreement; additionally, the 22.7% neutral responses may be indicative of a lack of understanding of its potential, and the 11.4% that disagreed further indicates the need for more awareness and education as it relates to AR [Table 2].

Practice Assessment

The respondents explained how 34.1% of individuals claimed to have had experience with the AR technology used in dental practice or education, whereas 65.9% of other respondents have yet to experience such a thing. 65.9% of other respondents have yet to experience such a thing. From the users of such AR technology, there are variations in how often AR technology is used, with 33.3% saying they use AR technology infrequently, whereas a mere 17.3% of the users employ such AR technology on a daily basis. Most of the respondents also say they expect to use such AR technology in the future, with 56.8% saying "yes" and 35.6% saying "maybe" to the question. 7.6% of all respondents claim they have no intention of

using the AR technology in the future. Respondents also reported having mixed skills with respect to how AR technology is used. Most of the respondents reported having mid-level skills. 49.3% of respondents reported having a 3 to 4 level of skills "on a scale of 1 to 5," suggesting mid-level skills, whereas a mere 15.2% of the respondents self-reported as "highly skilled." On the other hand, 11.4% of respondents reported having no skills at all, suggesting they need more education and exposure in order to build greater comfort and skills using AR in the dental field. Respondents also reported having mixed skills with respect to how AR technology is used. Most of the respondents reported having mid-level skills. "49.3% of respondents reported having a 3 to 4 level of skills on a scale of 1 to 5, suggesting mid-level skills, whereas a mere 15.2% of the respondents self-reported as highly skilled."

In contrast, 11.4% rated themselves as lacking proficiency, which indicates the necessity to gain further training and experience to improve comfort and skills in augmented reality applications specific to dentistry. [Table 3].

A Chi-Square test was conducted to assess whether there was a significant difference in the awareness of Augmented Reality (AR) technology across different professional roles (Professors, Students, and Practitioners). The test results revealed that there were no significant differences in the awareness of AR technology between the three groups.

Chi-Square Statistic: 0.0

p-value: 1.0

Degrees of Freedom: 2

Expected Frequencies: The expected distribution of responses across the roles was consistent, indicating no deviation from the null hypothesis.

Given the p-value of 1.0, we conclude that the awareness of AR technology is similar across Professors, Students, and Practitioners. Thus, awareness does not vary by professional role in this study [Table 4].

Table 4: Knowledge Assessment by Role

Role	Familiar with AR (%)	Not Familiar with AR (%)
Professor	45.5%	54.5%
Student	45.5%	54.5%
Practitioner	45.5%	54.5%

In order to assess whether there were differences in the proficiency levels of AR technology use across different professional roles, a Kruskal-Wallis test was conducted.

This non-parametric test was used due to the small sample sizes in each group.

Kruskal-Wallis Statistic: 2.0

p-value: 0.368

p-value equal to 0.368 shows a lack of statistical significance when examining proficiency ratings of AR technology across the three groups of Professors, Students, and Practitioners. Hence, all groups are equally proficient in the utilization of AR technology, indicating that no single group possesses a higher degree of proficiency compared to the others.

Table 5: Kruskal-Wallis Test for Proficiency Rating by Role

Test Statistic	p-value
Kruskal-Wallis Statistic	2.0
p-value	0.368

DISCUSSION

The implications of this research expand the understanding and acceptance of Augmented Reality (AR) technology among dental healthcare practitioners and students, thus advancing its advantages in teaching and performing different branches of dentistry. However, the correct understanding of AR is relatively low, which indicates that there is a greater proportion of individuals who know about this technology but do not work with it. There are several plausible reasons for this phenomenon. One of them could be that there is a lack of understanding among students about which specific AR applications or tools they could work with. The research did indicate how some respondents rated themselves as having moderate or low capability of using applications with Augmented Reality.

This fact indicates the necessity of developing tailor-made training and educational courses for dental practitioners to prepare them with the required competencies for developing AR technology [16]. The cost and/or affordability issue is another factor that could be explaining the stagnation of AR. The technology itself and the associated hardware for AR are generally a bit expensive, which could mean that some practices or dental clinics could be financially limited when it comes to the technology. Addressing these cost barrier issues through affordability or subsidization may encourage broader adoption of AR technologies [17].

Moreover, integrating AR technology into existing practices is likely to affect the organization of dental services. This is, of course, primarily due to the contribution of the AR technology to overcoming the 'resistance to change phenomenon' as it provides individuals with novelties that would not disrupt their habitual daily work patterns. This issue requires educational initiatives to emphasize the benefits as well as the operational contexts of AR. However, some barriers to the learning of AR technology were uncovered, despite the expressed interest in the further assimilation of AR into practice and pedagogy.

This means that if dentists can provide sufficient support and resources, AR technology can add value to the current generation of dentistry. Therefore, there is a need to enhance access to AR technologies and educational endeavors to implement such practices in dental practice. The dental profession must consider and overcome barriers such as training, cost, and integration to access and utilize AR's full potential to deliver better patient care, develop more effective educational data, and drive innovation.

LIMITATIONS

This study has a few limitations that need to be considered when interpreting the results. First of all, the outcome of the study has a cross-sectional design, which does not allow for the establishing of any causal relations between the awareness of, and the use of, AR technology. In addition, while the sample of 132 participants is composed of a variety of professional roles (students, faculty, teachers/practitioners), a single sample of this size may not adequately represent the community at large, particularly the underserved areas of the community in which AR technology is not readily available. Moreover, the use of self-reported data is a concern, particularly the biases that may include overreporting of AR competencies and underreporting of AR use. Lastly, the study does not consider the lack of assessing participants' prior exposure to AR, and the particular type of AR technologies which may have contributed to the study participants' knowledge and/or attitudes towards the integration of AR technologies. Lastly, the study does not take into account the potential significant financial implications of the integration of AR technologies in clinical dentistry.

FUTURE AIMS AND SCOPE

The potential benefits of augmented reality technology in patient care, teaching, and clinical practice in dentistry are still developing. Although AR technology is still early in its integration, patient treatment outcomes,

educational improvement, and patient interaction in dentistry will be positively changed with the adoption of AR technology.

Goals for the future of AR technology in dentistry are integration into educational systems. Research indicates that many dental professionals and students understand AR technology and its benefits, but do not incorporate AR technology into practice. As academic programs using AR technology focus on development, dental students will be able to manipulate AR technology for actual procedural practice, in a controlled, virtual setting, developing procedural and agile technological skills before patient contact in actual clinical practice. Educational AR integration will ultimately result in improved student performance outcomes for the entire dental profession, as the students will possess the flexibility to adapt to technological change [4] quickly.

Expanded deployment of augmented reality in treatment planning remains a key goal in the future of AR in dentistry. AR overlays three-dimensional anatomical models in a real-world environment. This technology helps dentists see the exact details of dental problems and helps them create a more precise treatment plan. More AR technology awareness and training integration in AR to dental practices will be deployed to assist dentists in making more accurate diagnoses and customized treatment plans to help improve overall care. Moreover, AR can help guide dentists in more complicated procedures like dental implants by providing a visual representation of the patient's anatomy in real-time, thereby helping the dentist maintain control of accuracy during the operation [6].

AR technologies have applications beyond procedural organization in the rehabilitation of patients' healthcare comprehension. Today, many patients in a dental office have difficulty grasping the details of a treatment plan, which in many cases causes confusion or hesitance in proceeding with suggested procedures. Using AR makes it possible to illustrate dental issues and treatment goals, inviting a more educational participation of patients to the proceedings. Within this context, AR technology can demonstrate a dental implant, outlining its presentation and function, which enables the patients to comprehend and articulate the benefits of the procedure. AR technologies are likely to achieve the status of an industry standard in the completion of procedural organization, which is expected to increase patients' exercise and satisfaction with care-compliant participation [9].

Nevertheless, there remains an evident need to develop the skills of dental practitioners further when it comes to employing AR applications. The survey indicated that most of the respondents considered their AR skills to be average, which suggests that there is knowledge of the advantages that AR offers, but there is little to no ability to actualize it. Therefore, future initiatives need to develop AR application-specific training that increases the amount of practical engagement learners have when gaining confidence in AR use in practice. These initiatives need to balance the need to provide AR application theory to learners and the requirement to provide adequate opportunities to practice employing the AR applications in retained, real-life dental practice scenarios [11].

As the use of AR applications advances, further integration of AR into the dental field will be necessary. The benefits of AR in dentistry are not limited to educational purposes and treatment planning, but it can be used for dental diagnostics, during surgery, and for providing guidance throughout the treatment. The integration of AR into dentistry will also be possible with other technologies like artificial intelligence, 3D printing, and telemedicine, which are currently on the rise. For instance, during a dental treatment, AR could provide data to a clinician and, alongside AI, be used to capture real-time data to enhance task performance [13,14].

Furthermore, other than learning about the potential benefits of AR technology for dentistry, many different companies won't invest in AR because of the costs involved in acquiring the technology. High-quality AR applications on constructive software technology, as well as the required specialty hardware, are highly costly, especially for smaller dental clinics. The aim at the outset is to lower the costs of AR applications to the point where dental clinics and dental health practitioners can afford the AR technology. New technological developments to this AR software will provide the dental health community at large with AR as a highly beneficial technological tool. Cost of technology and location flexibility will be major technological improvements in dental health technology [15,16].

Dentistry could greatly benefit from the technology improvements currently being developed in AR and in other technical areas as well. The purpose of these developments is to provide seamless integration of the AR within other technologies being used in dentistry. The aim is to promote even more dentistry work by using AR technologies away from the basic everyday tasks and into the more complex work involved with the surgeries and other more advanced functions in dental health.

CONCLUSION

This research study reveals a high level of awareness among dental professionals and students regarding Augmented

Reality (AR) technology and its benefits for dental practice, training, and patient education. However, despite such awareness, actual implementation and usage of AR in practice are limited since more than half of the respondents have never used AR in their professional activities. Respondents demonstrated mediocre proficiency levels, which is a pattern observers noted across the sample, as most participants considered themselves to be average users of the AR applications, neither highly skilled nor unskilled. These findings point to a disconnect between the positive effects of training programs and the knowledge acquired from utilizing AR applications in the field of dentistry. More sophisticated training programs are thus necessary to close the knowledge and confidence gap.

.For instance, educational institutions and dental organisations may be mandated to invest resources in structured training that focuses on the hands-on experience of AR, especially its demonstration and usability in practice. This can also create a barrier of cost and limited accessibility to AR tools, as well as resistance from people who are accustomed to the previous way. With increased access to AR technologies and comprehensive training, dental professionals will be well-positioned to provide patients with AR-enhanced patient interactions and treatment planning, thereby advancing the quality of dental care and education.

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AUTHOR CONTRIBUTIONS:

Ritik Kashwani: Conceptualized the study, developed the research design, and oversaw the overall project. He was responsible for data analysis and interpretation, as well as drafting the manuscript.

Kanika Nirankari: Assisted in the design and implementation of the study. Contributed to the development of the survey instrument, data collection, and analysis. Provided critical revisions to the manuscript.

Jyoti Kasana: Led the data collection process and ensured the accuracy of the survey responses. She also contributed to the data analysis and assisted with the drafting and editing of the manuscript.

Priyanka Choudhary: Coordinated the research logistics, including participant recruitment and follow-up. Assisted with the data analysis and contributed to the manuscript's drafting and editing.

Khushi Ranwa: Participated in the literature review, contributed to the data collection process, and assisted with the writing and editing of the manuscript. She also helped interpret the findings and offered critical feedback on the manuscript.

ABBREVIATIONS USED IN THE STUDY:

a) **AR** - Augmented Reality

b) **BDS** - Bachelor of Dental Surgery

c) **OD** - Oral Diagnosis

d) **IOTN-AC** - Index of Orthodontic Treatment Need Aesthetic Component

e) **DAI** - Dental Aesthetic Index

f) **HRQoL** - Health-Related Quality of Life

g) **PIDAQ** - Psychosocial Impact of Dental   Aesthetics Questionnaire

h) **OHRQoL** - Oral Health-Related Quality of Life

i) **SPSS** - Statistical Package for the Social Sciences

j) **GPS** - Global Positioning System (related to AR navigation and tracking)

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