Journal of Pioneering Medical Sciences
Received: July 29, 2025 | Accepted: August 28, 2025 | Published: September 05, 2025
Volume 14, Issue S02, Pages 202-206

DOI https://doi.org/10.47310/jpms202514S0231

Knowledge, Attitudes, and Practices Regarding USAG-1 for Tooth Regeneration Among Dental Professionals

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Abstract **Introduction**: Tooth loss continues to be a global health challenge with significant functional, psychological, and social consequences. Emerging evidence suggests that inhibition of USAG-1 (uterine sensitization-associated gene-1), a negative regulator of tooth development, may enable biological tooth regeneration. Understanding dental professionals' knowledge, attitudes, and practices (KAP) regarding this novel approach is critical for its future integration into clinical and educational frameworks. **Methods**: A descriptive cross-sectional survey was conducted among 195 dental professionals (60 students, 75 practitioners, and 60 faculty). A structured, pilot-tested, and content-validated questionnaire (20 items) assessed knowledge, attitudes, and practices related to USAG-1 and regenerative dentistry. Descriptive and inferential statistics (Chi-square and ANOVA) were performed using SPSS v25. **Results**: Of the participants, 68.2% had heard of USAG-1, yet only 41% correctly identified its biological mechanism. While 82% believed USAG-1 would impact clinical dentistry, only 36.4% felt confident discussing it with patients. Interest in formal training was high (73.8%). Significant differences were observed between students, practitioners, and faculty in knowledge and practice scores ($p<0.05$). **Conclusion**: Awareness of USAG-1 among dental professionals is promising, but critical gaps exist in mechanistic knowledge and clinical preparedness. Targeted curricular integration and continuing education are essential to bridge these gaps and responsibly translate preclinical research into future practice.

Key Words Tooth Regeneration, USAG-1, Regenerative Dentistry, Knowledge-Attitude-Practice (KAP), Dental Education

INTRODUCTION

Tooth loss resulting from caries, trauma, and periodontal disease remains a major global health problem with substantial impacts on quality of life, psychosocial wellbeing, and oral function [1]. Current treatment strategies, dentures, fixed prostheses, and dental implants, restore function but lack the developmental and regenerative properties of natural dentition [2].

Recent advances in regenerative medicine suggest the possibility of biological tooth replacement. USAG-1 (uterine sensitization-associated gene-1), also known as SOSTDC1, has emerged as a critical negative regulator of tooth development by antagonizing BMP and Wnt pathways [3,4]. Preclinical studies in mice and ferrets have shown that suppression of USAG-1 can stimulate de novo tooth formation, indicating potential for congenital tooth agenesis and acquired tooth loss therapies [5].

Despite promising preclinical data, translation into clinical dentistry requires not only scientific validation but also readiness among dental professionals. Knowledge, Attitudes, and Practices (KAP) surveys are effective tools to evaluate awareness, perceptions, and clinical preparedness in emerging biomedical technologies [6]. Previous KAP studies in regenerative medicine highlight gaps between awareness and application, as well as ethical and educational challenges [7].

Therefore, this study aimed to assess dental professionals' knowledge, attitudes, and practices regarding USAG-1 and its potential role in tooth regeneration.

Objectives

Primary Objective: To compare knowledge, attitudes, and practices regarding USAG-1 for tooth regeneration among dental students, practitioners, and faculty.

Secondary Objectives

- To identify demographic predictors of KAP scores
- To evaluate perceived barriers (confidence, ethics, education) to clinical application
- To recommend strategies for curricular and professional training in regenerative dentistry

METHODS

Study Design

Descriptive cross-sectional questionnaire-based survey.

Participants

A total of 195 dental professionals participated: 60 students (30.8%), 75 private practitioners (38.5%), and 60 faculty (30.8%).

Inclusion Criteria

Dental students enrolled in recognized institutions and licensed practitioners/faculty.

Exclusion Criteria

Non-dental professionals were excluded.

Questionnaire Development and Validation

A 20-item structured questionnaire was developed after literature review and expert consultation. Face and content validity were confirmed by three subject experts. A pilot study (n=20) yielded Cronbach's $\alpha = 0.82$, indicating good reliability.

Data Collection

Conducted via online forms between March-May 2024. The questionnaire included:

- Knowledge (8 items; multiple-choice, true/false)
- Attitude (7 items; five-point Likert scale)
- Practice (5 items; yes/no and Likert scale)

Data Analysis

Descriptive statistics (mean, SD, percentages) and inferential tests (Chi-square for categorical variables, one-way ANOVA for subgroup KAP comparisons) were applied using SPSS v25. $p<0.05$ was considered significant.

RESULTS

The study sample consisted of 195 participants, with a slight majority being male 56.4%(n=110). The remaining 43.6% (n=85) of participants were female. The age distribution revealed that the largest group was in the 20-29 years age range (41.0%, n=80), followed by the 30-39 years group (33.3%, n=65). Fewer participants were in the older age groups, with 17.9% (n=35) in the 40-49 years range and 7.7% (n=15) in the 50+ years category. The demographic breakdown is summarized in Table 1 and Figure 1.

Knowledge Assessment

The knowledge assessment revealed varying levels of awareness regarding USAG-1 and its role in tooth regeneration. A large proportion of participants 45.6%(n=89) agreed with the statement, "I have heard about USAG-1 and its role in tooth regeneration," while 22.6% (n=44) strongly agreed. However, 7.7% (n=15) strongly disagreed, and 8.7% (n=17) disagreed.

When asked about the inhibition of USAG-1 to allow regrowth of missing or undeveloped teeth, 31.8% (n=62) agreed, and 9.2% (n=18) strongly agreed. However, 12.3% (n=24) strongly disagreed with the statement. Knowledge about USAG-1's role in blocking BMP/Wntsignalling, which regulates tooth buds, showed that 28.7% (n=56) agreed with this statement, and 12.3% (n=24) strongly agreed. Table 2, Figure 2 provides a detailed summary of the knowledge assessment.

Attitude Assessment

The attitude assessment indicated strong support for the potential of USAG-1 in regenerative dentistry. A majority of participants 53.8%(n=105) agreed that USAG-1 will be a breakthrough in the field of tooth regeneration, while 28.2% (n=55) strongly agreed. Support for integrating regenerative dentistry into standard curricula was also high, with 56.4% (n=110) agreeing and 32.3% (n=63) strongly agreeing. Ethical concerns regarding tooth regrowth were acknowledged by 36.9% (n=72), who agreed, and 19.5% (n=38) strongly agreed. The question of whether it is too early to rely on USAG-1 therapeutically in humans showed a more divided response, with 50.3% (n=98) agreeing, while 15.4% (n=30) strongly agreed. These findings are presented in Table 3, Figure 3.

Practice Assessment

Regarding the practice assessment, only 21.5% (n=42) of participants had discussed USAG-1 with patients or colleagues. However, 36.4% (n=71) felt confident explaining the regenerative mechanism to patients, and 73.8% (n=144) expressed interest in receiving formal training

Table 1: Demographics of gender and age group

Variable	Number (n=195)	Percentage (%)
Gender		
Male	110	56.4%
Female	85	43.6%
Age Groups		
20–29 years	80	41.0%
30–39 years	65	33.3%
40–49 years	35	17.9%
50+ years	15	7.7%

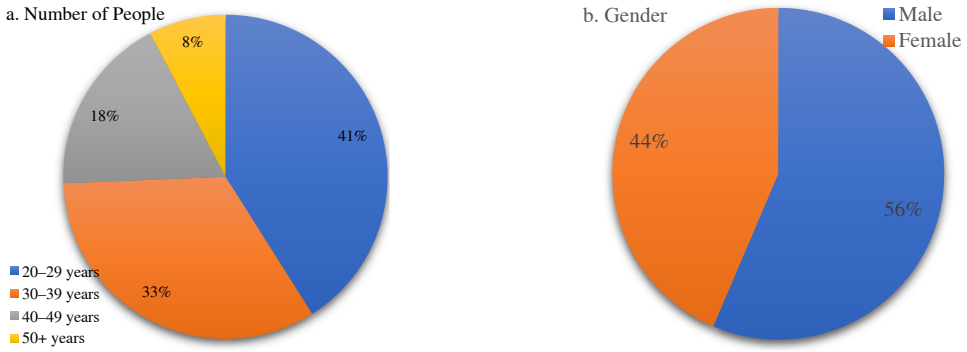

Figure 1(a,b): Demographics of gender and age group

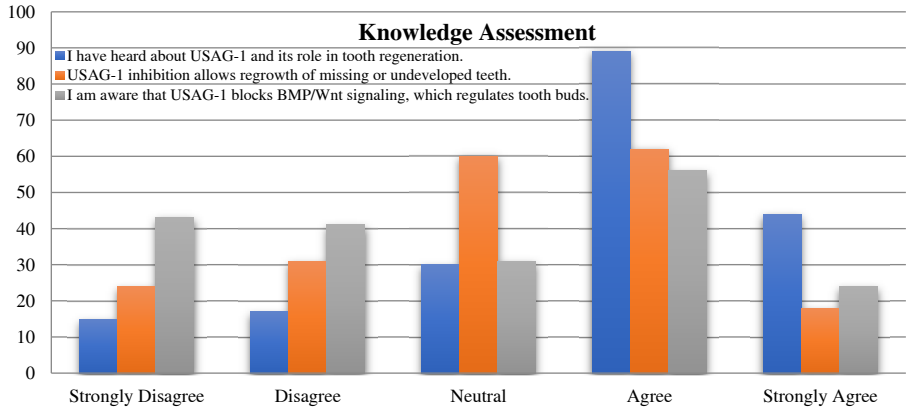

Figure 2: Knowledge assessment of scientific understanding of the mechanism of USAG-1

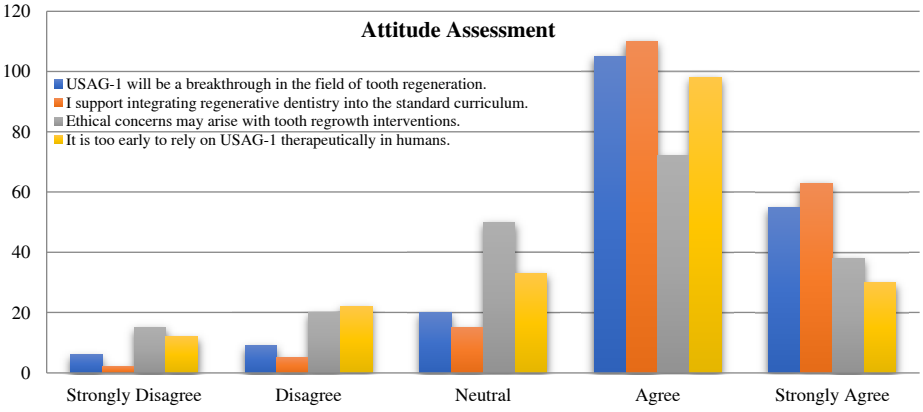

Figure 3: Attitude assessment of perceptions of regenerative dentistry

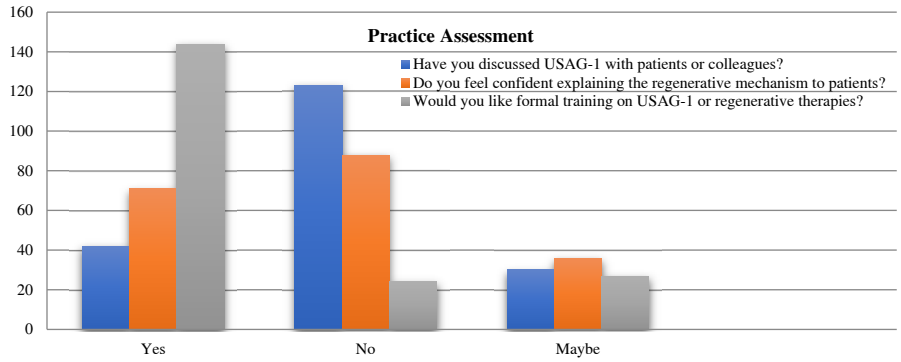

Figure 4: Practice assessment of readiness and patient interaction

Table 2: Knowledge assessment of scientific understanding of the mechanism of USAG-1

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I have heard about USAG-1 and its role in tooth regeneration.	15 (7.7%)	17 (8.7%)	30 (15.4%)	89 (45.6%)	44 (22.6%)
USAG-1 inhibition allows regrowth of missing or undeveloped teeth.	24 (12.3%)	31 (15.9%)	60 (30.8%)	62 (31.8%)	18 (9.2%)
I am aware that USAG-1 blocks BMP/Wntsignalling, which regulates tooth buds.	43 (22.1%)	41 (21.0%)	31 (15.9%)	56 (28.7%)	24 (12.3%)

Table 3: Attitude assessment of perceptions of regenerative dentistry

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
USAG-1 will be a breakthrough in the field of tooth regeneration.	6 (3.1%)	9 (4.6%)	20 (10.3%)	105 (53.8%)	55 (28.2%)
I support integrating regenerative dentistry into the standard curriculum.	2 (1.0%)	5 (2.6%)	15 (7.7%)	110 (56.4%)	63 (32.3%)
Ethical concerns may arise with tooth regrowth interventions.	15 (7.7%)	20 (10.3%)	50 (25.6%)	72 (36.9%)	38 (19.5%)
It is too early to rely on USAG-1 therapeutically in humans.	12 (6.2%)	22 (11.3%)	33 (16.9%)	98 (50.3%)	30 (15.4%)

Table 4: Practice assessment of readiness and patient interaction

Question	Yes	No	Maybe
Have you discussed USAG-1 with patients or colleagues?	42 (21.5%)	123 (63.1%)	30 (15.4%)
Do you feel confident explaining the regenerative mechanism to patients?	71 (36.4%)	88 (45.1%)	36 (18.5%)
Would you like formal training on USAG-1 or regenerative therapies?	144 (73.8%)	24 (12.3%)	27 (13.8%)
Are you likely to adopt USAG-1-based therapies in the future?	121 (62.1%)	33 (16.9%)	41 (21.0%)

training on USAG-1 or regenerative therapies. When asked about the likelihood of adopting USAG-1-based therapies in the future, 62.1% (n=121) were likely to adopt these therapies, while 16.9% (n=33) were unlikely. These results are summarized in Table 4, Figure 4.

DISCUSSION

Targeting USAG-1 and its potential for tooth regeneration, this investigation highlights the growing understanding among dentists regarding regenerative dentistry. Underlining a clear distinction between surface-level awareness and in-depth knowledge, which has been earlier confirmed by studies published by W. Zhang et al. in (2021), a relatively high proportion (68.2%) of the respondents said they knew USAG-1; yet, a rather smaller number (41%), could exactly explain its methodology [8]. This disparity between knowledge and application parallels patterns observed in other domains of dental innovation, where recently acquired scientific ideas become popular before being fully incorporated into clinical understanding and treatment.

The data of attitude assessment reveals a good receptivity to change since 82% of participants thought that USAG-1-based regenerative treatments would greatly affect clinical dentistry, supported by the studies done by Panahi et al [9]. Lack of confidence, however, dampened this enthusiasm; just 36.4% of dentists felt at ease talking about such treatments with patients. This discrepancy between excitement and preparation highlights a need for focused training courses that cover passive understanding, skill development, and practical confidence-building.

Furthermore, the strong interest in formal training expressed by 74% of respondents reinforces the urgency of embedding regenerative dentistry, particularly USAG-1-related content, into both undergraduate curricula and continuing dental education (CDE). The anti-USAG-1 treatment consistently resulted in tooth regeneration, involving the establishment of a third dentition or rescue of the tooth germ in numerous mammalian models. These findings draw attention to the realistic non-cell-based therapeutic possibilities of anti-USAG-1 for congenital tooth agenesis suggested in preclinical studies done by Sinha et al. [10].

Dentists must be able not only to grasp but also to critically evaluate, explain, and ethically apply regenerative technology in patient treatment, from experimental phases to early clinical trials. By closing this preparation gap, we can ensure that innovative findings in oral biology led to a notable enhancement of public dental health. The paper emphasises generally the need for proactive educational changes to close the knowledge-practice gap and prepare dental practitioners for the era of biologically based tooth regeneration [11]. This study highlights a discrepancy between awareness and mechanistic understanding of USAG-1 among dental professionals. While 68.2% had heard of the gene, only 41% could accurately describe its biological function. Similar gaps have been observed in early adoption studies of stem cell therapies [8].

Attitudes were largely positive, with most participants expecting USAG-1 to influence clinical practice. However, lack of confidence in communication mirrors findings from other regenerative dentistry KAP surveys [9]. The demand for formal training suggests that structured education is urgently needed to bridge the knowledge-practice gap.

Ethical concerns, raised by over half of respondents, align with broader debates in tissue engineering [11]. Preclinical status of USAG-1 therapy further underscores the need for cautious optimism rather than premature clinical expectations.

Overall, subgroup differences (higher knowledge among faculty, greater adoption intent among practitioners) suggest that tailored training strategies are necessary.

CONCLUSIONS

USAG-1 represents a promising target for biological tooth regeneration, but current knowledge and preparedness among dental professionals remain limited. Although enthusiasm is high, lack of mechanistic understanding and confidence pose barriers. Integration of regenerative dentistry into curricula, continuing dental education, and ethical discourse is essential for preparing the profession for future translation of USAG-1 research.

Ethical Statement

Approval was obtained from the Institutional Ethics Committee, D.Y. Patil Dental School, Pune (IEC No: DYPD/ETH/2024/021). Informed consent was obtained from all participants.

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