Check for updates

Dental Traumatology

WILEY

Dental Traumatology

ORIGINAL ARTICLE OPEN ACCESS

Usability Evaluation and Longitudinal Educational Outcomes of the ToothSOS Application for Parental Emergency Management of Traumatic Dental Injuries

Makbule Buse Dundar Sari | Tuğba Aydoğdu | Berkant Sezer

Department of Pediatric Dentistry, School of Dentistry, Çanakkale Onsekiz Mart University, Çanakkale, Türkiye

Correspondence: Makbule Buse Dundar Sari (dundarbuse94@gmail.com)

Received: 22 February 2026 | **Revised:** 21 April 2026 | **Accepted:** 13 August 2026

Keywords: knowledge retention | mobile health application | parental education | system usability scale | ToothSOS | traumatic dental injuries

ABSTRACT

Background/Aim: Appropriate first-aid management of traumatic dental injuries (TDIs) is highly time-sensitive and critically influences prognosis. Parents frequently represent the first point of contact following injury. Although the ToothSOS mobile application (App) is based on current guidelines of the International Association of Dental Traumatology, evidence integrating usability assessment using validated instruments with longitudinal knowledge retention in parental populations remains limited. This study evaluated the usability of the ToothSOS App using the validated System Usability Scale (SUS) and examined parental knowledge gain and retention over time.

Materials and Methods: In this prospective longitudinal questionnaire-based study, parents were assessed at baseline (T0), immediately after application use (T1), and one month later (T2). Knowledge of fracture and avulsion management was measured using standardized true–false items. Perceived usability, the primary outcome, was assessed using the SUS. Nonparametric repeated-measures analyses were performed.

Results: A total of 149 parents completed all assessments. The ToothSOS App demonstrated high perceived usability, with a mean SUS score of 78.4 ± 8.3, exceeding the established benchmark for above-average usability. Knowledge scores differed significantly across time points (Friedman $\chi^2 = 187.920$, $p < 0.001$), increasing from a median of 5 (IQR: 2) at baseline to 9 (IQR: 2) at T1 and remaining elevated at 8 (IQR: 3) at one month. The proportion of parents reporting adequate management knowledge increased markedly over time ($p < 0.001$), accompanied by significant improvements in confidence ($p < 0.001$). An apparent negative association was observed between baseline knowledge and knowledge retention (Spearman's rho $= -0.557$, $p < 0.001$).

Conclusion: This study demonstrates that the ToothSOS App is not only educationally effective but also highly usable. Integrating usability assessment using a validated measurement instrument with longitudinal evaluation of knowledge and confidence provides a clinically meaningful framework for optimizing digital first-aid tools in time-sensitive dental trauma management.

1 | Introduction

Traumatic dental injuries (TDIs) remain a prevalent public health problem during childhood and adolescence, with important functional, aesthetic, and psychosocial consequences [1, 2]. Many injuries occur in everyday environments such as schools and homes, where immediate professional care may be unavailable [3]. In such situations, first-aid actions taken within the first minutes are critical determinants of prognosis [4].

Parents are frequently the first responders when a child sustains a TDI and therefore play a key role in the acute phase of trauma management. However, multiple studies consistently report insufficient parental knowledge regarding appropriate emergency

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2026 The Author(s). *Dental Traumatology* published by John Wiley & Sons Ltd.

procedures, including correct storage media, handling of avulsed teeth, and urgency of referral [5–7]. These findings, confirmed across different countries and populations, indicate a persistent global educational need [6, 8].

The International Association of Dental Traumatology (IADT) emphasizes that appropriate first-aid measures and timely emergency care are essential to maximize favorable treatment outcomes and long-term prognosis following TDIs [9, 10]. Although evidence-based IADT guidelines are regularly updated, effective dissemination of this information to non-dental caregivers remains challenging. Recent ToothSOS-focused studies indicate that digital, guideline-based education can improve immediate knowledge of TDI management; however, these effects may diminish over time when exposure is limited to a single intervention, underscoring the need for accessible, repeatable, and sustainable educational tools in dental trauma education [5, 7, 11].

In this context, mobile health applications have gained increasing attention as practical tools capable of delivering guideline-based information rapidly and in a user-friendly manner. The ToothSOS mobile application (App), developed by the IADT, provides step-by-step, evidence-based first-aid guidance for TDIs. Beyond content accuracy, the practical usability of such digital tools is a critical determinant of real-world effectiveness, particularly during stressful emergency situations. The application is designed to serve both the public and dental professionals through content aligned with current IADT protocols [12, 13].

Despite the growing number of studies investigating ToothSOS, important gaps remain. Most investigations have focused on immediate or short-term knowledge changes among parents, students, or healthcare professionals following application use [5, 7, 13–15]. Evidence regarding longer-term knowledge retention remains limited, and usability has been insufficiently investigated using validated instruments in longitudinal parental populations. Consequently, the sustainability and real-world applicability of ToothSOS-based parental education interventions remain unclear.

Therefore, the aim of the present study was to primarily evaluate the usability of the ToothSOS App using a validated measurement instrument and to secondarily assess parental knowledge gain and retention using a longitudinal pre–post–follow-up design. The null hypothesis was that the application would not result in significant differences in perceived usability or parental knowledge across assessment time points.

2 | Materials and Methods

2.1 | Study Design and Ethical Approval

This prospective, questionnaire-based study employed a longitudinal pre–post–follow-up design to evaluate the usability of the ToothSOS App using a validated instrument (System Usability Scale) as the primary outcome, and parental knowledge gain and knowledge retention as secondary outcomes.

The study protocol was approved by the Çanakkale Onsekiz Mart University Health Sciences Ethics Committee (approval number: 2025/16) and was conducted in accordance with the principles of the Declaration of Helsinki. Written informed consent was obtained from all participants prior to enrollment. Participation was voluntary, and all data were collected using unique participant codes to ensure confidentiality.

2.2 | Sample Size Calculation

The sample size was calculated using G*Power version 3.1 (Faul, Erdfelder, Lang, & Buchner; Heinrich Heine University, Düsseldorf, Germany) following an approach commonly used in similar ToothSOS-based educational intervention study [5]. Based on a repeated-measures longitudinal design and an assumed effect size of $f = 0.598$ derived from prior educational intervention research, the minimum required sample size was 122 participants for a two-sided significance level of 0.05 and a statistical power of 95%.

2.3 | Participants and Eligibility Criteria

Parents or primary caregivers who accompanied their children to the Department of Pediatric Dentistry, School of Dentistry, Çanakkale Onsekiz Mart University, were invited to participate in the study. Eligible participants were required to be the parent or legal guardian of at least one child, be between 20 and 50 years of age, have the ability to read and understand Turkish, and own a smartphone compatible with the ToothSOS App. Parents were excluded if they had a professional background in dentistry, had previously received formal education regarding the management of TDIs, had prior experience using the ToothSOS App, or reported a history of training in the management of TDIs. Participants reporting prior awareness of the ToothSOS App but no previous active use were not excluded. No participants meeting the predefined exclusion criteria were included in the final analytical sample. Individuals with hearing, speech, or cognitive impairments were also excluded.

2.4 | Intervention and Study Procedure

Assessments were conducted at three time points: before exposure to the application (T0), immediately after application use (T1), and one month following the intervention (T2). The intervention consisted of the use of the ToothSOS App, developed by the IADT. The application provides evidence-based, step-by-step guidance for the emergency management of TDIs, including dental fractures and tooth avulsion, in accordance with current IADT guidelines. At baseline (T0), participants completed questionnaires assessing sociodemographic characteristics, self-reported confidence, and baseline knowledge regarding the management of TDIs. Participants were then instructed to independently explore the ToothSOS App without additional guidance to isolate the effect of the application itself. Participants were instructed to explore the application until they felt sufficiently familiar with its main functions and trauma management guidance. They were specifically asked to review sections related to dental fractures and tooth avulsion, corresponding to the knowledge assessment. In practice, the exploration period typically lasted approximately 15–20 min. No predefined navigation sequence was imposed, as the intervention was designed

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

to reflect naturalistic user interaction. The post-intervention assessment (T1) was conducted immediately after this supervised exploration period.

2.5 | Knowledge Assessment

Parental knowledge was assessed using a structured questionnaire consisting of true–false items addressing key aspects of the management of TDIs, including immediate response to dental fractures, avulsion management, appropriate storage media, and urgency of professional referral.

The questionnaire was specifically developed for the present study based on the educational content provided by the ToothSOS App and current IADT guidelines. Item content and structure were formulated through independent expert review by three pediatric dentists, each with more than 10 years of clinical experience in pediatric dental trauma management, to ensure clinical relevance and content validity. The questionnaire was subsequently reviewed in consultation with a biostatistician to confirm methodological appropriateness. To enhance comprehensibility for non-dental caregivers, the wording of the knowledge questions was deliberately kept simple and non-technical.

Prior to the main study, a pilot evaluation was conducted with a small group of parents ($n = 10$) to assess item clarity, comprehensibility, and readability, and minor wording revisions were made to eliminate potential ambiguities. The same knowledge questionnaire was administered at T0, T1, and T2 to evaluate immediate knowledge gain and knowledge retention. Responses were linked across time points using unique participant codes, enabling within-subject (paired) intra-individual comparisons. To minimize recall bias, the order of the knowledge questions was varied across T0, T1, and T2 administrations; however, the content of the questions remained identical. For statistical analysis, corresponding items were matched across time points based on their content, and total knowledge scores were calculated accordingly for within-subject comparisons.

2.6 | Confidence and Trust Measures

Self-reported confidence and trust were assessed using single-item Likert-type questions. Confidence in managing a TDI ("I feel confident managing a dental trauma situation") was measured at all three time points (T0, T1, and T2) using a five-point Likert scale ranging from "strongly disagree" to "strongly agree." Trust in the information provided by the ToothSOS App ("I trust the information obtained from the ToothSOS App") was measured at T1 and T2 using the same five-point Likert scale. These ordinal responses were analyzed using nonparametric repeated-measures tests.

2.7 | Usability Assessment

Perceived usability of the ToothSOS App, the primary outcome of the study, was evaluated at T1 using the SUS. The validated Turkish version of the SUS (SUS-TR), which has demonstrated satisfactory reliability and validity in Turkish populations, was employed [16]. The SUS consists of 10 items rated on a five-point Likert scale, yielding a total score ranging from 0 to 100, with higher scores indicating better perceived usability. Scoring was performed according to standard SUS procedures. In line with established interpretive guidance, a score of 68 was considered the threshold for above-average usability [17].

2.8 | Additional Follow-Up Measures

At T2, participants completed additional questions assessing continued use of the ToothSOS App and their willingness to recommend the application to others. These items were included to explore real-world engagement and perceived practical value beyond immediate educational outcomes.

2.9 | Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics software (version 26.0; IBM Corp., Armonk, NY, USA). Participants who did not complete the one-month follow-up assessment were excluded from longitudinal analyses, and all repeated-measures analyses were conducted using a complete-case approach. To evaluate the potential risk of attrition bias, baseline characteristics of participants who completed the follow-up and those lost to follow-up were compared. Repeated assessments at T0, T1, and T2 were analyzed using within-subject (paired) repeated-measures approaches. Descriptive statistics were calculated for all variables. Categorical variables were summarized as frequencies and percentages, whereas continuous variables were presented as means with standard deviations or medians with interquartile ranges (IQR), as appropriate. The distribution of continuous variables was assessed using the Shapiro–Wilk test. Because most continuous outcome variables, including knowledge scores, confidence ratings, and SUS scores, were not normally distributed ($p < 0.05$), nonparametric statistical methods were applied for inferential analyses. Perceived usability, defined as the primary outcome, was quantified using SUS total scores and summarized descriptively.

Parental knowledge regarding the emergency management of TDIs was expressed as a total knowledge score calculated from the sum of correct responses at each time point. Changes in knowledge scores across T0, T1, and T2 were analyzed using the Friedman test for repeated measures, and when significant, post hoc pairwise comparisons were conducted using the Wilcoxon signed-rank test with Bonferroni correction (adjusted $p < 0.017$). Changes in categorical repeated measures, such as the proportion of parents reporting that they knew how to manage a TDI, were evaluated using Cochran's Q test followed by McNemar tests with Bonferroni adjustment. Item-level changes in individual knowledge questions across T0, T1, and T2 were also analyzed using Cochran's Q test with post hoc McNemar pairwise comparisons and Bonferroni correction. Ordinal confidence ratings were analyzed using the Friedman test with post hoc Wilcoxon signed-rank tests.

Knowledge retention was operationalized as the within-subject change score between follow-up and baseline

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

(ΔKnowledge = T2 − T0), representing the magnitude of retained knowledge improvement after one month. Associations between knowledge retention and continuous variables were assessed using Spearman's rank correlation coefficient, whereas differences across categorical variables were evaluated using the Mann–Whitney *U* or Kruskal–Wallis tests, as appropriate. All statistical tests were two-tailed, and a p-value < 0.05 was considered statistically significant unless otherwise specified. Because change scores (ΔKnowledge = T2 − T0) inherently include baseline values, correlations involving baseline knowledge and change scores were interpreted cautiously due to the potential influence of mathematical coupling and regression-to-the-mean effects.

3 | Results

A total of 169 parents were enrolled at T0. Of these, 20 participants declined to participate in the T2 follow-up assessment, resulting in a final analytical sample of 149 parents. Baseline comparisons between participants who completed the follow-up and those lost to follow-up showed no statistically significant differences in age, gender distribution, education level, baseline knowledge scores, or baseline confidence levels (all $p > 0.05$). Most participants were female ($n = 101$, 67.8%), while 48 participants (32.2%) were male. The mean age of the participants was 35.9 ± 6.7 years (median: 35 years; range: 20–50 years). The mean number of children per participant was 1.8 ± 0.8 (median: 2; range: 1–4). Regarding educational background, most participants had a university-level education ($n = 90$, 60.4%), followed by high school graduates ($n = 50$, 33.6%). A smaller proportion had completed secondary school ($n = 6$, 4.0%) or primary school education ($n = 3$, 2.0%). Only 16 participants (10.7%) reported having a family member or close relative with a dental education background, whereas 133 participants (89.3%) did not. A history of dental trauma in the family was reported by 21 participants (14.1%), while 128 participants (85.9%) reported no such history. Prior awareness of the ToothSOS App was very limited; only 2 participants (1.3%) reported having previous knowledge of the application, whereas 147 participants (98.7%) had not heard of ToothSOS App before participating in the study. Importantly, none of the participants reported prior active use of the application. The detailed sociodemographic characteristics of the study population are presented in Table 1.

The proportion of parents reporting that they knew how to manage a TDI differed significantly across the three time points (Cochran's $Q = 188.803$, df = 2, $p < 0.001$). The percentage of affirmative responses increased from baseline (T0: 17.4%) to immediately after application use (T1: 96.0%) and remained higher at the one-month follow-up (T2: 84.6%). Although a slight decline was observed at T2 compared with T1, the proportion of parents reporting adequate knowledge remained considerably higher than baseline. Post hoc pairwise comparisons using the McNemar test with Bonferroni correction demonstrated that the increase was statistically significant from baseline to immediately after application use (T0 vs. T1, $p < 0.017$) and from baseline to one-month follow-up (T0 vs. T2, $p < 0.017$), whereas no statistically significant difference was observed between the immediate post-intervention and follow-up assessments (T1 vs. T2, $p > 0.017$).

TABLE 1 | Sociodemographic characteristics of the participants ($n = 149$).

Variable	Category	*n* (%) or Mean ± SD
Gender	Female	101 (67.8)
	Male	48 (32.2)
Age (years)		35.9 ± 6.7
Education level	Primary school	3 (2.0)
	Secondary school	6 (4.0)
	High school	50 (33.6)
	University	90 (60.4)
Dentist in family/close relatives	Yes	16 (10.7)
	No	133 (89.3)
History of dental trauma in the family	Yes	21 (14.1)
	No	128 (85.9)
Prior awareness of the ToothSOS mobile application	Yes	2 (1.3)
	No	147 (98.7)
Number of children		1.8 ± 0.8

Note: Values are presented as number (percentage) or mean ± standard deviation (SD).

Parental confidence in managing dental trauma also differed significantly across the three time points (Friedman test, $\chi^2 = 97.802$, df = 2, $p < 0.001$). Mean rank values were lowest at baseline (T0: 1.47), higher immediately after application use (T1: 2.49), and 2.03 at the one-month follow-up. Post hoc pairwise comparisons using the Wilcoxon signed-rank test with Bonferroni correction showed a significant increase in confidence from T0 to T1 and from T0 to T2 ($p < 0.017$), whereas no significant difference was observed between T1 and T2 ($p > 0.017$).

Parents' trust in the information provided by the ToothSOS App differed significantly between the immediate post-intervention and one-month follow-up assessments (Wilcoxon signed-rank test, $Z = -4.502$, $p < 0.001$). Although a statistically significant decline in trust scores was observed at follow-up, a substantial proportion of participants demonstrated unchanged trust levels over time.

Immediately after application use, almost all parents reported that they would recommend the ToothSOS App to others ($n = 147$, 98.7%). At the one-month follow-up, more than half of the participants indicated that they had actively recommended the application to others ($n = 88$, 59.1%). In addition, 25 parents (16.8%) reported having used the ToothSOS App during the follow-up period.

Knowledge scores differed significantly across the three time points (Friedman test, $\chi^2 = 187.920$, df = 2, $p < 0.001$). Mean rank values indicated the lowest knowledge at baseline (T0: 1.21), a marked increase immediately after application use (T1: 2.73), and a partial decline at the one-month follow-up (T2: 2.06),

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

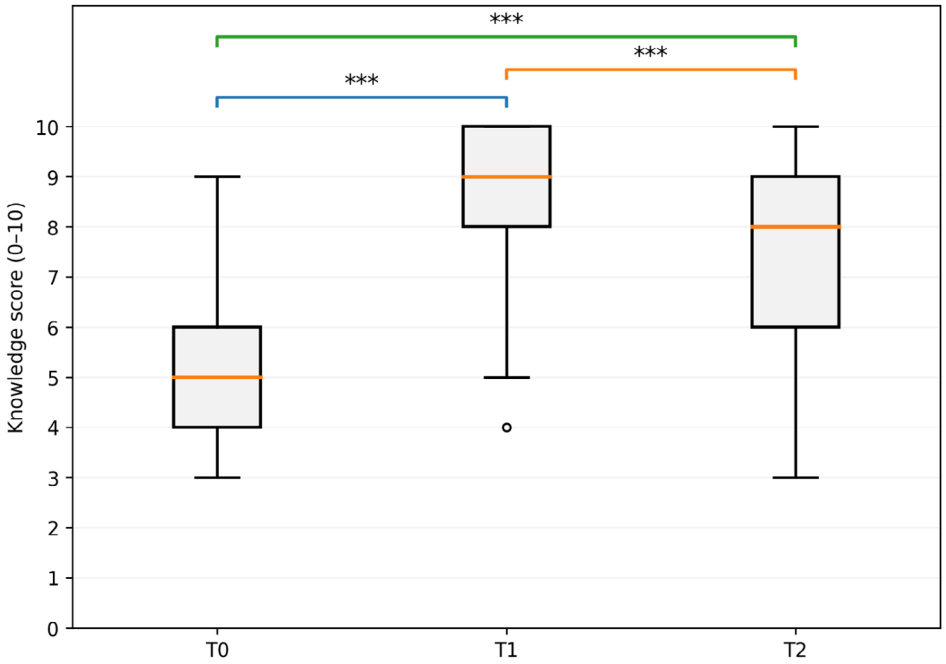


FIGURE 1 | Changes in parental knowledge scores over time. Boxplots illustrate the distribution of knowledge scores (0–10) at baseline (T0), immediately after application use (T1), and at the one-month follow-up (T2). The horizontal line within each box represents the median, boxes indicate the interquartile range (IQR; 25th–75th percentiles), whiskers extend to 1.5×IQR, and points denote outliers. Knowledge scores increased significantly from T0 to T1 and remained higher at T2 compared with baseline, although a significant decrease was observed between T1 and T2. Statistically significant pairwise differences after Bonferroni correction are indicated ($p < 0.017$). Overall group differences were assessed using the Friedman test ***$p < 0.001$.

while knowledge levels remained higher than baseline. Median knowledge scores increased from 5 (IQR: 2) at baseline to 9 (IQR: 2) immediately after application use and remained elevated at 8 (IQR: 3) at one-month follow-up.

Post hoc pairwise comparisons using the Wilcoxon signed-rank test with Bonferroni correction ($p < 0.017$) demonstrated significant differences between all time points. Knowledge scores increased significantly from baseline to immediately after application use (T0 vs. T1, $Z = -10.281$, $p < 0.001$, $r = 0.84$) and from baseline to one-month follow-up (T0 vs. T2, $Z = -9.028$, $p < 0.001$, $r = 0.74$). A significant decrease was observed between the immediate post-intervention and follow-up assessments (T1 vs. T2, $Z = -7.777$, $p < 0.001$, $r = 0.64$), although knowledge scores at follow-up remained significantly higher than baseline (Figure 1). The frequency distribution of responses to each knowledge item across the three assessment points is presented in Table 2.

To further examine changes at the item level, Cochran's Q test revealed statistically significant differences across time points for all knowledge items except Q3 (all $p < 0.001$) (Table 2). Post hoc McNemar tests with Bonferroni correction identified significant increases in correct responses from T0 to T1 and from T0 to T2 for items Q1, Q4, Q6, Q7, and Q9 (all $p < 0.017$). For Q2, significant differences were observed across all pairwise comparisons (T0–T1, T1–T2, and T0–T2; all $p < 0.017$). For Q8, a significant increase was observed from T0 to T1, followed by a significant decrease from T1 to T2 ($p < 0.017$). For Q10, all pairwise comparisons were statistically significant ($p < 0.017$). In contrast, Q5 demonstrated significant differences between T0–T1 and T0–T2 ($p < 0.017$), while no statistically significant difference was observed between T1 and T2. No statistically significant differences were observed for Q3 across time points ($p > 0.05$).

The ToothSOS App demonstrated high perceived usability among parents. The mean SUS score was 78.4 ± 8.3, with scores ranging from 60 to 100, indicating good to excellent overall usability according to established SUS benchmarks [17]. The internal consistency of the SUS was acceptable (Cronbach's alpha = 0.76). Item-level descriptive statistics are presented in Table 3. Among individual items, the highest mean score was observed for the statement "I would imagine that most people would learn to use this system very quickly" (SUS7: 4.38 ± 0.49), whereas the lowest mean score was observed for "I needed to learn a lot of things before I could get going with this system" (SUS10: 1.42 ± 0.50).

Exploratory analyses were conducted to identify factors associated with knowledge retention. No significant associations were observed between knowledge retention and age (Spearman's rho = −0.073, $p = 0.375$), gender (Mann–Whitney $U = 2174.0$, $p = 0.303$), prior dental trauma experience (Mann–Whitney $U = 1309.0$, $p = 0.847$), education level (Kruskal–Wallis $H = 4.105$, $p = 0.250$), or perceived usability as measured by the SUS total score (Spearman's rho = 0.055, $p = 0.507$). In contrast, a significant moderate-to-strong negative correlation was observed between baseline knowledge scores and knowledge retention (Spearman's rho = −0.557, $p < 0.001$), indicating that parents with lower initial knowledge levels experienced greater improvements following use of the ToothSOS App. These associations are summarized in the Spearman correlation heatmap (Figure 2).

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

TABLE 2 | Frequency distribution (%) of respondents' answers.

Question			T0 *n* (%)	T1 *n* (%)	T2 *n* (%)	*p*
Q1. "There is no need to look for a broken piece of a tooth after a dental injury." Do you think this statement is true or false?	Correct answer	False	57 (38.3)	144 (96.6)	131 (87.9)	**<0.001**
	Incorrect answer	True	92 (61.7)	5 (3.4)	18 (12.1)	
Q2. "A broken piece of a tooth should be kept dry before taking it to the dentist." Do you think this statement is true or false?	Correct answer	False	48 (32.2)	138 (92.6)	74 (49.7)	**<0.001**
	Incorrect answer	True	101 (67.8)	11 (7.4)	75 (50.3)	
Q3. "Even if a broken tooth looks like a minor injury, a dentist should be consulted immediately." Do you think this statement is true or false?	Correct answer	True	148 (99.3)	145 (97.3)	141 (94.6)	0.063
	Incorrect answer	False	1 (0.7)	4 (2.7)	8 (5.4)	
Q4. "If a permanent tooth is completely knocked out of the mouth, there is no need to look for the tooth." Do you think this statement is true or false?	Correct answer	False	47 (31.5)	145 (97.3)	133 (89.3)	**<0.001**
	Incorrect answer	True	102 (68.5)	4 (2.7)	16 (10.7)	
Q5. "If a permanent tooth that has come out completely is found, it should be placed back into its position by holding it from any part of the tooth." Do you think this statement is true or false?	Correct answer	False	137 (91.9)	89 (59.7)	65 (43.6)	**<0.001**
	Incorrect answer	True	12 (8.1)	60 (40.3)	84 (56.4)	
Q6. "If a permanent tooth comes out completely, it can be briefly rinsed with water and placed back into its position, even if there is bleeding." Do you think this statement is true or false?	Correct answer	True	10 (6.7)	138 (92.6)	129 (86.6)	**<0.001**
	Incorrect answer	False	139 (93.3)	11 (7.4)	20 (13.4)	
Q7. "To save a permanent tooth that has come out completely, a dentist should be consulted as soon as possible. The most critical time is the first 20 min." Do you think this statement is true or false?	Correct answer	True	94 (63.1)	145 (97.3)	140 (94.0)	**<0.001**
	Incorrect answer	False	55 (36.9)	4 (2.7)	9 (6.0)	
Q8. "If a permanent tooth cannot be placed back into the mouth, it should be wrapped in a dry tissue and taken to the dentist." Do you think this statement is true or false?	Correct answer	False	89 (59.7)	130 (87.2)	72 (48.3)	**<0.001**
	Incorrect answer	True	60 (40.3)	19 (12.8)	77 (51.7)	
Q9. "If a permanent tooth cannot be placed back immediately, it should be kept moist, for example in milk or saliva, and a dentist should be consulted immediately." Do you think this statement is true or false?	Correct answer	True	30 (20.1)	140 (94.0)	126 (84.6)	**<0.001**
	Incorrect answer	False	119 (79.9)	9 (6.0)	23 (15.4)	
Q10. "Whether the tooth is a baby tooth or a permanent tooth, it should be placed back into its position if found." Do you think this statement is true or false?	Correct answer	False	140 (94.0)	121 (81.2)	103 (69.1)	**<0.001**
	Incorrect answer	True	9 (6.0)	28 (18.8)	46 (30.9)	

Note: The data are presented as numbers (percentages). Bold values mean statistically significant. *p* values were calculated using Cochran's *Q* test for overall comparisons across time points. Pairwise comparisons were performed using McNemar tests with Bonferroni correction ($p < 0.017$).

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

TABLE 3 | Item-level descriptive statistics for the System Usability Scale (SUS).

SUS item	Mean ± SD
SUS1. I think that I would like to use this system frequently	3.15 ± 1.09
SUS2. I found the system unnecessarily complex	1.67 ± 0.51
SUS3. I thought the system was easy to use	4.24 ± 0.43
SUS4. I think that I would need the support of a technical person to be able to use this system	1.47 ± 0.51
SUS5. I found the various functions in this system were well integrated	3.93 ± 0.44
SUS6. I thought there was too much inconsistency in this system	2.34 ± 0.63
SUS7. I would imagine that most people would learn to use this system very quickly	4.38 ± 0.49
SUS8. I found the system very cumbersome to use	1.51 ± 0.50
SUS9. I felt very confident using the system	4.09 ± 0.48
SUS10. I needed to learn a lot of things before I could get going with this system	1.42 ± 0.50

Note: Values are presented as mean ± standard deviation (SD).

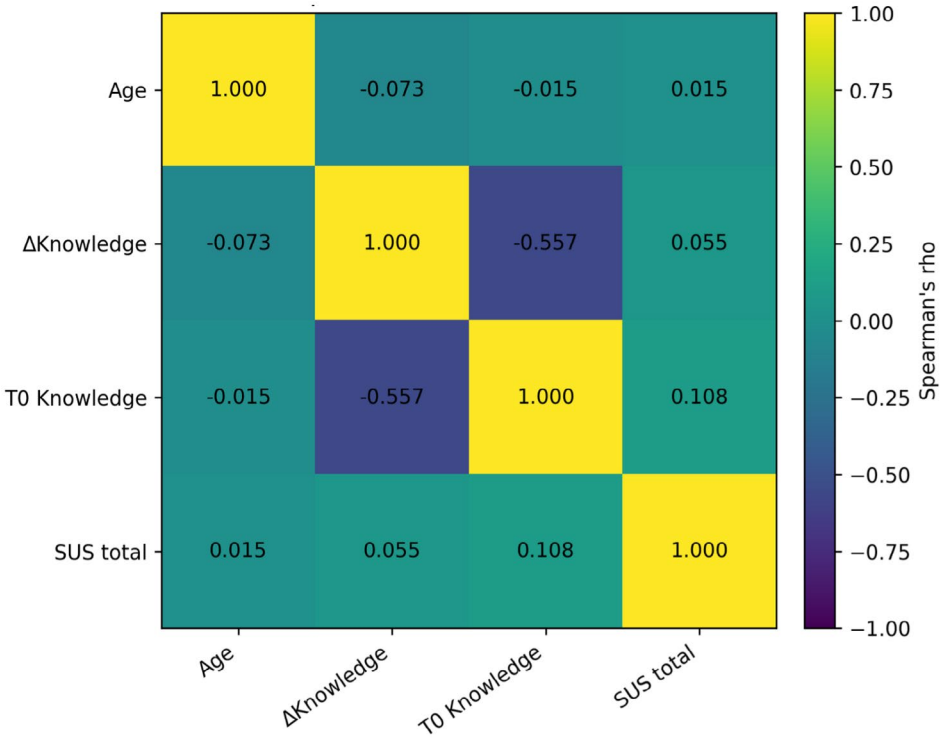


FIGURE 2 | Spearman correlation heatmap of exploratory relationships among study variables. Age: participant age (years); ΔKnowledge: change in knowledge score between one-month follow-up and baseline (T2–T0); T0 Knowledge: baseline knowledge score; SUS total: total System Usability Scale score.

4 | Discussion

The present longitudinal study was designed to evaluate the usability of the ToothSOS App using a validated instrument as the primary outcome and to examine parental knowledge gain and retention as secondary outcomes within the same prospective cohort. The findings demonstrated favorable usability of the ToothSOS App among parents, as reflected by high SUS scores, together with statistically significant improvements in knowledge, preparedness, and confidence across assessment time points. Accordingly, the null hypothesis was rejected.

Although several investigations have evaluated the educational impact of the ToothSOS App, formal usability assessment using validated instruments has not been reported to date. Duruk and Gümüşboğa reported significant post-training knowledge gains among non-dentists but did not assess usability using standardized instruments [15]. Similarly, Barutcigil and Öz demonstrated improved parental awareness after exposure to the application without a psychometric evaluation of user experience [5]. Khehra et al. described the dissemination of the application within the IADT, yet usability was not quantified using validated scales [12]. In contrast, the

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

current study incorporated the SUS, a validated and widely accepted tool, and demonstrated high usability scores, indicating that parents perceived the application as intuitive and easy to operate.

Item-level analysis of the SUS responses provides additional insight into specific usability dimensions of the application. Items reflecting ease of learning and general usability demonstrated consistently high agreement, particularly the statement indicating that most users would learn to use the system quickly (SUS7). Similarly, items related to perceived ease of use and user confidence (SUS3 and SUS9) yielded high mean scores, suggesting that the application was generally perceived as intuitive and user-friendly. In contrast, negatively worded items addressing system complexity and the need for extensive prior learning received low agreement scores, further supporting the absence of perceived difficulty in using the application. However, comparatively lower agreement regarding willingness for frequent use may indicate a potential area for improving user engagement in future iterations. Overall, these findings suggest that the application performs strongly in core usability domains, particularly learnability and ease of use, while highlighting specific aspects that may benefit from further optimization.

These usability findings are clinically relevant because effective emergency tools must be not only informative but also readily usable under stressful conditions. Therefore, usability assessment should be considered a prerequisite rather than an adjunct when evaluating digital first-aid tools for dental trauma, particularly in the context of time-critical emergency decision-making in pediatric dental trauma.

Within this context, digital and mobile health tools are increasingly used in *Dental Traumatology* to improve access to emergency information and decision support. Previous studies have highlighted the growing role of smartphones and mobile applications in trauma management, emphasizing the importance of usability and accessibility when developing such tools [18–21].

In dental trauma management, parents often represent the first link in the chain of care. Early actions taken at the site of injury strongly influence the prognosis of traumatized teeth, particularly in relation to periodontal ligament vitality and pulp survival [22, 23]. Therefore, improving parental knowledge and preparedness is essential for effective emergency response.

Consistent with the baseline findings of the present study, insufficient parental knowledge regarding the emergency management of traumatic dental injuries has been widely reported across different populations. Previous cross-sectional studies from various regions have documented substantial deficiencies in caregivers' understanding of avulsion management, appropriate storage media selection, and the urgency of professional consultation [6, 24–26]. The extremely low prior awareness of the ToothSOS App observed among participants in this study (1.3%) further supports the limited public familiarity with validated digital trauma guidance tools. Together, these findings suggest that inadequate preparedness for dental trauma remains an important gap in community-level emergency response.

Digital and media-based interventions have been proposed to address these deficiencies. Educational animations, web-based trauma resources, and structured digital platforms have demonstrated improvements in user knowledge, particularly regarding critical first-aid steps [27–29]. In the present study, knowledge scores increased markedly immediately after application use and remained significantly higher than baseline at one month. The partial decline observed at follow-up may reflect the classical "forgetting curve" phenomenon described in cognitive psychology, whereby learned information diminishes over time without reinforcement. Nevertheless, retention remained clinically meaningful, suggesting that even single-exposure digital interventions can produce sustained short-term learning effects. Importantly, the knowledge improvements observed in this study should be interpreted as indicators of educational learning following exposure to the application rather than direct measures of real-world trauma management performance. In addition, the use of a brief true/false instrument may have introduced ceiling effects in post-intervention assessments, potentially limiting sensitivity for detecting more subtle differences and attenuating associations with other variables, including usability. These findings emphasize the importance of incorporating reinforcement mechanisms and continuity components into digital trauma education strategies.

At the item level, response patterns indicated that changes following application exposure were not uniform across all knowledge domains, reflecting a pattern of heterogeneous learning. While several items showed consistent and sustained increases in correct responses, others—particularly those related to technical aspects of avulsion management (e.g., tooth handling and storage conditions; Q5 and Q8)—demonstrated more variable trajectories over time. Notably, certain items (particularly Q5 and Q10) showed a decrease in correct responses following application use, with further decline at follow-up in some cases. These findings suggest that, in specific content areas, exposure to the application may have led to partial misunderstanding or misinterpretation rather than consistent knowledge acquisition. Overall, this pattern highlights domain-specific variability in learning outcomes despite the overall improvement in total knowledge scores.

Beyond factual knowledge, previous studies have emphasized that appropriate emergency responses depend on caregivers' perceived competence and self-efficacy. Tian et al. reported that hesitation to intervene during dental trauma often stems from low confidence and fear of causing harm rather than a complete lack of information [8]. Community-based studies further demonstrate that parents may struggle to recognize mild or asymptomatic injuries and to accurately assess injury severity, potentially delaying referral and increasing the risk of unfavorable outcomes [30–32]. Moreover, TDIs exert considerable psychosocial impact on families; visible bleeding, pain, and aesthetic disruption are associated with heightened anxiety, guilt, and decisional uncertainty [33–35]. In this context, the significant post-intervention increases observed in both knowledge and self-reported preparedness in the present study suggest that digital trauma education may contribute to greater perceived readiness and decisional clarity under stress, although real-time behavioral performance was not directly evaluated. Improvements in confidence may represent a potential mediator

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

between knowledge acquisition and real-world action, a relationship that warrants further behavioral investigation.

Similar barriers have been described among teachers and other lay responder groups, where differences in baseline experience and familiarity with trauma protocols influence emergency decision-making in TDIs [36]. These findings further support the need for structured, guideline-based educational tools that enhance decisional confidence in non-dental responders.

The high willingness to recommend the application and the continued use reported at follow-up provide indirect evidence of real-world acceptability. In dental traumatology, where emergency events are relatively infrequent yet time-critical, sustained engagement with educational tools may represent a scalable and cost-effective strategy to enhance community-level preparedness for pediatric dental trauma. The relatively limited repeated use observed during the follow-up period may therefore reflect the episodic nature of traumatic dental injuries, where guidance tools are typically consulted primarily when an injury occurs rather than through routine daily use.

Exploratory correlation analyses (Figure 2) provided additional insight into the relationships between baseline knowledge, knowledge retention, usability, and participant characteristics. A negative association was observed between baseline knowledge and knowledge retention (ΔKnowledge), suggesting that participants with lower initial knowledge tended to exhibit greater improvement over time, a pattern consistent with prior educational research [5, 15]. However, this association should be interpreted with caution, as change-score analyses are inherently influenced by mathematical coupling and regression-to-the-mean effects. Therefore, the observed correlation does not necessarily reflect a true underlying relationship. In contrast, no meaningful associations were identified between knowledge retention and participant age or perceived usability (SUS total score), suggesting that usability and learning outcomes were not directly linked under the present study conditions. From a public health perspective, improving baseline knowledge remains important, particularly for caregivers with limited prior exposure to dental trauma [37]. Overall, these findings should be considered exploratory, and no causal inference can be drawn given the observational design of the study.

Taken together, these findings suggest that high perceived usability does not necessarily translate into greater knowledge improvement or retention. While usability is essential for accessibility and user engagement, it may not be the primary determinant of learning effectiveness in digital trauma education. Instead, variability in learning outcomes may be more strongly influenced by factors such as baseline knowledge and content-specific complexity. This highlights the importance of evaluating usability and educational outcomes as related but distinct constructs, as high usability alone does not guarantee optimal knowledge acquisition or retention.

The present study has several strengths. The longitudinal design incorporating repeated assessments allowed evaluation of both immediate learning and subsequent knowledge retention over time, within the same parental cohort. Use of a validated usability instrument provided standardized and objective measurement of user experience. Recruitment of parents from a routine clinical setting enhanced ecological validity and reflected real-world caregiver populations. Furthermore, the combined assessment of knowledge, confidence, and perceived usability enabled a comprehensive and multidimensional evaluation of both educational effectiveness and practical applicability of the application.

Nevertheless, several limitations should be acknowledged. Outcomes were based on self-reported measures rather than observed behavioral performance; therefore, the extent to which improved knowledge translates into appropriate real-time management during actual trauma events remains uncertain. In addition, because the same knowledge questionnaire was administered across repeated assessments, improvements in post-intervention scores may partly reflect familiarity with the test items in addition to the educational exposure itself. Although the order of the questions was randomized across T0, T1, and T2 to reduce recall bias, repeated testing may still have contributed to higher post-intervention scores. Therefore, the magnitude of knowledge improvement should be interpreted with caution. Future studies incorporating randomized controlled designs or parallel-form knowledge instruments would provide stronger causal inference regarding the educational impact of the application. The single-center design and relatively short follow-up period may also limit generalizability and long-term inference. Additionally, the study sample consisted predominantly of caregivers with relatively high educational attainment and a higher proportion of women. These characteristics may have influenced both baseline knowledge levels and engagement with the application and may limit the generalizability of the findings, particularly to populations with lower educational levels or more gender-balanced distributions. Although baseline comparisons between participants who completed the follow-up and those lost to follow-up showed no statistically significant differences, the possibility of attrition bias cannot be fully excluded, particularly given the relatively small number of participants lost to follow-up. Because the follow-up interval was limited to one month, the observed improvements should be interpreted as reflecting short-term knowledge retention. Longer follow-up periods may yield different patterns, including potential declines in knowledge over time. Additionally, exposure time and specific interaction patterns were not formally quantified, which may limit the precision of intervention fidelity assessment and should be considered when interpreting the findings. Despite these limitations, the within-subject longitudinal design and the standardized intervention protocol strengthen internal validity by minimizing contextual variability across participants. Because the educational content of the ToothSOS App is based on internationally standardized IADT guidelines, the observed usability and knowledge patterns may reasonably extend beyond the local clinical context, although confirmation through multicenter studies would further strengthen external validity.

Future research should incorporate longer follow-up intervals, randomized controlled comparisons with alternative educational strategies, and simulation-based or scenario-driven behavioral assessments to evaluate whether gains in knowledge and confidence translate into accurate real-time trauma management and guideline-consistent clinical decision-making.

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Incorporating high-fidelity simulation models or timed decision tasks may provide more ecologically valid assessment of caregiver performance under stress and help bridge the knowledge–behavior gap identified in digital trauma education research.

5 | Conclusions

The current study demonstrates that the ToothSOS App is both highly usable and educationally effective for parents. Use of the application was associated with improved parental knowledge, sustained knowledge retention, increased preparedness, and greater confidence in the emergency management of TDIs. By combining usability assessment using a validated measurement instrument with a longitudinal evaluation of educational outcomes, this study provides clinically relevant evidence supporting the practical applicability of guideline-based mobile health tools for non-dental caregivers. Integrating such digital resources into routine preventive dental education may represent a feasible and scalable strategy to improve timely and appropriate first-aid responses following pediatric dental trauma.

Author Contributions

M.B.D.S. and B.S. conception and study design; M.B.D.S. and T.A. methodology; T.A. investigation; T.A. and B.S. data acquisition and analysis; M.B.D.S. visualization; B.S. supervision; M.B.D.S. and B.S. writing – original draft preparation; M.B.D.S., T.A., and B.S. writing – reviewingand editing. All authors have read and agreed to the published versionof the manuscript.

Acknowledgments

The authors have nothing to report.

Funding

The authors have nothing to report.

Ethics Statement

This study protocol was reviewed and approved by the Çanakkale Onsekiz Mart University Health Sciences Ethics Committee (Approval No.: 2025/16).

Consent

Informed consent was obtained from all participants and their legal guardians.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author (M.B.D.S.) upon reasonable request.

References

1. U. L. F. Glendor, "Epidemiology of Traumatic Dental Injuries–A 12 Year Review of the Literature," *Dental Traumatology* 24, no. 6 (2008): 603–611.

2. S. Petti, U. Glendor, and L. Andersson, "World Traumatic Dental Injury Prevalence and Incidence, A Meta-Analysis—One Billion Living People Have Had Traumatic Dental Injuries," *Dental Traumatology* 34, no. 2 (2018): 71–86.

3. K. V. Saikiran, D. Gurunathan, S. Nuvvula, R. K. Jadadoddi, R. H. Kumar, and U. C. Birapu, "Prevalence of Dental Trauma and Their Relationship to Risk Factors Among 8–15-Year-Old School Children," *International Journal of Dentistry* 2022, no. 1 (2022): 3343827.

4. J. O. Andreasen, F. M. Andreasen, and L. Andersson, eds., *Textbook and Color Atlas of Traumatic Injuries to the Teeth* (John Wiley & Sons, 2018).

5. G. Barutcigil and E. Oz, "Evaluation of Parental Awareness on Emergency Management of Traumatic Dental Injuries: The Role of the ToothSOS Application," *Dental Traumatology* 41, no. 6 (2025): 667–679.

6. N. Tewari, S. Goel, S. Srivastav, et al., "Global Status of Knowledge of Parents for Emergency Management of Traumatic Dental Injuries: A Systematic Review and Meta-Analysis," *Evidence-Based Dentistry* 24, no. 2 (2023): 91.

7. C. Bal, Z. Öztürk, D. Atak, M. Yaşar, and M. Aksoy, "Evaluation of Parents' Awareness Levels of Traumatic Dental Injuries: The Toothsos Mobile Application and "Save Your Tooth" Posters," *International Dental Research* 13, no. 2 (2023): 60–66.

8. J. Tian, J. J. J. Lim, F. K. C. Moh, A. Siddiqi, J. Zachar, and S. Zafar, "Parental and Training Coaches' Knowledge and Attitude Towards Dental Trauma Management of Children," *Australian Dental Journal* 67 (2022): S31–S40.

9. L. Levin, P. F. Day, L. Hicks, et al., "International Association of Dental Traumatology Guidelines for the Management of Traumatic Dental Injuries: General Introduction," *Dental Traumatology* 36, no. 4 (2020): 309–313.

10. A. F. Fouad, P. V. Abbott, G. Tsilingaridis, et al., "International Association of Dental Traumatology Guidelines for the Management of Traumatic Dental Injuries: 2. Avulsion of Permanent Teeth," *Dental Traumatology* 36, no. 4 (2020): 331–342.

11. M. Ozdemir, H. Comert, and A. S. Ataç, "Effect of the ToothSOS Mobile Application on Dental Students' Knowledge of Emergency Management of Traumatic Dental Injuries: A Comparative Study," *Dental Traumatology* 42 (2025): 202–211.

12. A. Khehra, N. Cohenca, Z. C. Cehreli, and L. Levin, "The International Association of Dental Traumatology ToothSOS Mobile App: A 2-Year Report," *Dental Traumatology* 37, no. 1 (2021): 145–150.

13. M. B. D. Sari, E. Sari, C. Bal, and M. Aksoy, "Evaluation of the Knowledge Level of Pediatricians on Dental Trauma and Their Awareness of the ToothSOS Mobile Application: A Cross Sectional Study," *Dental Traumatology* 40, no. 2 (2024): 195–203.

14. G. C. Sevencan, E. Ç. Güzel, and B. Topçu, "A Cross-Sectional Study to Evaluate Family Physicians' Awareness of the ToothSOS Mobile Application and Factors Affecting Their Knowledge of Dental Trauma," *Dental Traumatology* 42 (2025): 212–220.

15. G. Duruk and Z. Ş. Gümüşboğa, "Effectiveness of the ToothSOS App as a Training Tool for the Emergency Management of Traumatic Dental Injuries Among Non-Dentists," *Dental Traumatology* 38, no. 3 (2022): 229–237.

16. D. Demirkol and Ç. Şeneler, "A Turkish Translation of the System Usability Scale: The SUS-TR," *Uşak Üniversitesi Sosyal Bilimler Dergisi* 11, no. 3 (2018): 237–253.

17. M. Hyzy, R. Bond, M. Mulvenna, et al., "System Usability Scale Benchmarking for Digital Health Apps: Meta-Analysis," *JMIR mHealth and uHealth* 10, no. 8 (2022): e37290.

18. C. Zaror, G. Espinoza-Espinoza, C. Atala-Acevedo, et al., "Validation and Usability of a Mobile Phone Application for Epidemiological

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License

Surveillance of Traumatic Dental Injuries," *Dental Traumatology* 35, no. 1 (2019): 33–40.

19. S. Djemal, "Smartphones and Dental Trauma: The Current Availability of Apps for Dental Trauma," *Dental Traumatology* 32, no. 1 (2016): 159–164.

20. B. Huang, M. Estai, P. Pungchanchaikul, et al., "Mobile Health Assessment of Traumatic Dental Injuries Using Smartphone-Acquired Photographs: A Multicenter Diagnostic Accuracy Study," *Telemedicine and e-Health* 30, no. 10 (2024): 2592–2600.

21. T. Walia, M. S. Muthu, A. Saikia, R. M. Shetty, and R. P. Anthonappa, "Are Mobile Health Applications for Traumatic Dental Injuries Effective? A Systematic Review of Their Impact on Diagnosis, Prevention, Management, and Education," *European Archives of Paediatric Dentistry* 27, no. 2 (2026): 255–274.

22. H. Fadel, S. Mousa, T. Al-Harbi, et al., "Parental Knowledge of Traumatic Dental Injuries Explained by First Aid Training and Education: A Cross-Sectional Study," *Journal of Clinical Pediatric Dentistry* 49, no. 6 (2025): 40–47.

23. W. Aierken, A. Ayoufu, R. Abuduweili, et al., "Knowledge and Practice Gaps in the Emergency Management Practices of Children With Dental Trauma: A Cross-Sectional Survey Among Primary School Health Teachers and Parents in Urumqi," *BMC Oral Health* 25, no. 1 (2025): 1480.

24. Z. Momeni, S. Afzalsoltani, and M. Moslemzadehasl, "Mothers' Knowledge and Self-Reported Performance Regarding the Management of Traumatic Dental Injuries and Associated Factors: A Cross-Sectional Study," *BMC Pediatrics* 22, no. 1 (2022): 665.

25. M. Al Sheeb, F. A. Al Jawad, and H. Nazzal, "Parents' Knowledge of Emergency Management of Avulsed Permanent Teeth in Children and Adolescents in the State of Qatar: A Questionnaire Cross-Sectional Study," *European Archives of Paediatric Dentistry* 24, no. 5 (2023): 643–650.

26. G. Sivaramakrishnan, D. Abawi, F. M. Shoaib, et al., "Can Parents Prevent Tooth Loss Related to Dental Avulsion? An Assessment of Knowledge Related to Permanent Teeth," *Journal of Trauma and Injury* 36, no. 1 (2023): 15–21.

27. N. Özveren and S. Yıldırım, "Effectiveness of an Educational Cartoon Animation on the Knowledge of Children About Traumatic Dental Injuries," *Dental Traumatology* 38, no. 6 (2022): 512–518.

28. J. M. Loureiro, V. C. V. Chaves, P. A. Risso, M. B. Magno, L. C. Maia, and M. M. Pithon, "YouTube™ as a Source of Tooth Avulsion Information: A Video Analysis Study," *Dental Traumatology* 39, no. 6 (2023): 616–624.

29. E. Yılmaz and E. Eden, "Preparation and Quality Assessment of a Dental Trauma Website," *Selcuk Dental Journal* 12, no. 1 (2025): 104–109.

30. V. P. Costa, C. C. Amaral, M. L. Goettems, R. T. Pinheiro, and F. F. Demarco, "Maternal Perception of the Occurrence of Traumatic Dental Injuries in Children: A Cohort Study of South Brazil," *International Dental Journal* 66, no. 3 (2016): 163–168.

31. M. L. Ramos-Jorge, J. Ramos-Jorge, I. Mota-Veloso, K. J. Oliva, P. M. Zarzar, and L. S. Marques, "Parents' Recognition of Dental Trauma in Their Children," *Dental Traumatology* 29, no. 4 (2013): 266–271.

32. C. de Oliveira Rodrigues, L. J. S. Lima, K. L. R. de Sousa, et al., "Determinants of Parental Awareness of Dental Trauma in Preschool Children," *Dental Traumatology* 42 (2025): 306–312.

33. M. C. Gomes, M. A. Clementino, T. C. Pinto-Sarmento, et al., "Association Between Parental Guilt and Oral Health Problems in Preschool Children: A Hierarchical Approach," *BMC Public Health* 14, no. 1 (2014): 854.

34. D. Sakaryalı Uyar, T. Uyar, and B. Memiş Özgül, "Attitudes and Emotional Status of Parents Regarding Traumatic Dental Injuries," *Dental Traumatology* 39, no. 1 (2023): 2–10.

35. A. K. Kesava, F. Gilroy, B. K. D. Motidyang, A. Meldrum, and M. Ekambaram, ""It Was Surprising in a Bad Way": The Experiences of Children/Adolescents With Dental Avulsion and Their Family in New Zealand," *Dental Traumatology* 42 (2026): 437–445.

36. B. Öter, E. Y. Çetiner, and B. Arıcan, "X, Y, and Z Generation Differences in Emergency Responses to Traumatic Oral and Dental Injuries Among Primary School Teachers in Türkiye," *Dental Traumatology* 42 (2025): 329–337.

37. Z. Ş. Gümüşboğa and F. Pacci, "Comparison of Knowledge Levels of Parents Whose Children Have and Have Not Experienced Permanent Dental Avulsion," *European Archives of Paediatric Dentistry* 27 (2025): 453–461.

16009657, 0, Downloaded from https://onlinelibrary.wiley.com/doi/10.1111/edt.70119 by Berkant Sezer - Canakkale Onsekiz Mart Uni , Wiley Online Library on [01/09/2026]. See the Terms and Conditions (https://onlinelibrary.wiley.com/terms-and-conditions) on Wiley Online Library for rules of use; OA articles are governed by the applicable Creative Commons License