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Knowledge and Practice on Dental Avulsion Management Among General Dentists in Isfahan: A Cross-Sectional Study

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Abstract

Objective(s): Dental avulsion is a serious dental trauma that requires timely and appropriate management to ensure favorable outcomes. The aim of the present study was to assess the knowledge and clinical practice of general dentists regarding dental avulsion management. **Methods:** A cross-sectional study was conducted in 2024 among 129 general dentists in Isfahan, Iran. A structured, researcher-designed questionnaire assessed knowledge (16 items), and practice (10 items) related to dental avulsion management, focusing on critical extra-alveolar time, optimal storage media, antibiotic prophylaxis, endodontic treatment timing, and availability of educational materials, based on international guidelines. Data were analyzed using Student's t-test and Kruskal-Wallis test to evaluate the associations between knowledge and practice scores and demographic variables (gender and years of experience). **Results:** The mean knowledge and practice scores were 4.97 ± 1.26 and 5.39 ±1.61, respectively, indicating moderate levels. Regarding knowledge, most dentists correctly identified the critical extra-alveolar time, while less than half recognized the optimal storage medium and appropriate timing for revascularization in open apex teeth. Approximately one-fourth acknowledged the need for antibiotic prophylaxis, and mostly underestimated the adverse effects of storing avulsed teeth in tap water. In terms of practice, about 15% had educational materials on dental avulsion in their clinics, and over 90% expressed a need for further training. No significant associations were found between knowledge scores and gender (p= 0.42), or years of experience (p= 0.43). Similarly, practice scores were not significantly associated with gender (p=0.23), or years of experience (p=0.66). **Conclusion:** General dentists in Isfahan demonstrated moderate knowledge and clinical practice regarding dental avulsion management, with notable gaps in key areas such as storage media, antibiotic prophylaxis, and revascularization potential. These findings highlight the need for structured continuing education programs and the dissemination of clinical guidelines to improve the management of dental avulsions.

Keywords: Tooth Avulsion; Dentists; Clinical Competence; Knowledge; Professional Practice

Introduction

Dental avulsion, defined as the complete displacement of a tooth from its socket due to trauma, is a serious dental emergency that requires prompt and appropriate management to maximize the chances of successful reimplantation and long-term survival of the tooth[1]. Avulsed anterior teeth constitute a significant proportion of traumatic dental injuries, particularly among children and adolescents, and their proper management is essential for preserving both function and aesthetics[2].The prognosis of an avulsed tooth largely depends on factors such as extraoral dry time, storage medium, and timely execution of appropriate treatment protocols [1, 3, 4].

To standardize care and improve outcomes, the International Association of Dental Traumatology (IADT) has developed evidence-based guidelines for the emergency management of avulsed teeth [1, 5].These guidelines emphasize immediate reimplantation whenever feasible or placement of the avulsed tooth in an appropriate storage medium, such as Hank's Balanced Salt Solution, milk, or saline, to maintain periodontal ligament cell viability until professional intervention [1, 3]. Adherence to such protocols is crucial to prevent complications like root resorption and ankylosis, thereby improving long-term treatment outcomes [1].

Despite the availability of well-established guidelines, studies worldwide indicate considerable variability in dentists' knowledge and attitude. In developed countries, such as European nations, general dentists generally demonstrate higher awareness and compliance with recommended avulsion management protocols [6, 7]. Conversely, research in developing countries such as Iran highlights significant gaps in knowledge, preparedness, and the use of appropriate storage media, which may adversely affect patient outcomes[8, 9].

In neighboring countries, such as Turkey and Saudi Arabia, similar challenges have been reported. Studies reveal inadequate knowledge among general dental practitioners regarding timely reimplantation and proper storage media, indicating a regional need for targeted educational interventions [10, 11]. These findings suggest that even where guidelines exist, gaps in practical knowledge and preparedness may persist, emphasizing the importance of context-specific assessment.

In Iran, although several studies have evaluated dental trauma management, research specifically addressing general dentists' knowledge and clinical practices regarding dental avulsion remains limited, especially in major urban centers like Isfahan [9, 12]. Existing evidence indicates insufficient coverage of dental trauma management in undergraduate curricula and continuing education programs, contributing to variability in dentists' preparedness. Moreover, public unawareness and delayed referral further complicate case management [13]. These factors highlight a clear information gap regarding region-specific knowledge and practice patterns among Iranian general dentists.

Given the scarcity of comprehensive, local data on dental avulsion management in Isfahan, conducting this study was necessary to identify the existing levels of awareness and clinical practices, and to provide a foundation for future educational interventions tailored to the region. This study aimed to evaluate the knowledge and clinical practices of general dentists in Isfahan regarding the management of dental avulsion.

Methods

Study Design and Population

This analytical cross-sectional study was conducted in 2024, adhering to the STROBE guidelines for cross-sectional studies to ensure methodological rigor and transparency [14]. The target population included all general dentists actively practicing in public and private clinics in Isfahan, Iran. Participants were recruited through the Iranian Dental Association – Isfahan Branch. Initially, an electronic invitation was sent to all registered general dentists, followed by targeted reminders to improve response rates. Eligibility criteria included having a valid dental license, at least one year of clinical experience, and active practice in general dentistry. Dentists working exclusively in specialties without patient contact were excluded.

Sample Size

Based on prior studies evaluating knowledge of dental avulsion [8, 15], and assuming a moderate effect size (Cohen's d = 0.5), a power of 80%, and a significance level of 0.05, the minimum required sample size for comparing knowledge scores between groups was calculated to be 128 participants. To account for potential incomplete or missing responses, the final target sample size was set at 129 dentists.

Questionnaire Development and Variables

Data were collected using a structured, researcher-designed questionnaire (Suppl.1) developed through a comprehensive review of the literature and international guidelines, including the IADT 2018 guidelines [16]. The questionnaire consisted of three main domains:

1. **Knowledge** (16 items): assessing theoretical understanding of avulsion management, including:
   - Critical time for reimplantation
   - Appropriate storage media for avulsed teeth
   - Handling of contaminated teeth
   - Use of splints and follow-up protocols
   - Pain management and antibiotic prophylaxis
2. **Practice** (10 items): evaluating clinical approach such as:
   - Availability of educational materials in clinics
   - Adherence to IADT protocols in clinical scenarios
   - Patient education practices
   - Emergency management readiness
3. **Demographics and Professional Background** (6 items): age, gender, years of experience, type of clinic, prior training in dental trauma, and participation in continuing education courses.

Each knowledge item was scored 1 for a correct answer and 0 for incorrect or missing responses (total score: 0–16). Practice items were scored similarly (total score: 0–10). Scores were categorized into low, moderate, and high using tertiles.

Questionnaire Validation and Reliability

The preliminary questionnaire was reviewed by a panel of ten experts in oral surgery and endodontics to establish content validity, focusing on four aspects: necessity, relevance, clarity, and simplicity. The Content Validity Ratio (CVR) for each item exceeded 0.78, and the Content Validity Index (CVI) for the overall questionnaire was 0.91, indicating excellent validity. Face validity was also assessed by experts and a pilot group of 15 dentists to ensure comprehensibility and clarity of wording. For reliability, internal consistency was measured using Cronbach's alpha coefficient. The questionnaire was completed by 15 dentists during the pilot study, yielding a Cronbach's alpha of 0.83, confirming good reliability.

Data Collection Procedure

After validation, the final questionnaire was distributed electronically. Dentists were invited to complete it voluntarily and anonymously. Targeted follow-ups were used to ensure adequate participation and response rates.

Ethical Consideration

This study was approved by the Research Ethics Committee of Islamic Azad University, Isfahan (Khorasgan) Branch (Approval ID: IR.IAU.KHUISF.REC.1403.18). Written informed consent was obtained from all participants, and the research adhered to ethical principles and national

regulations for medical research in Iran.

Data Analysis

Data were analyzed using SPSS version 26. Descriptive statistics included means, standard deviations, and frequency distributions of demographic variables and questionnaire scores. Inferential analyses included Student's t-test for comparing two independent groups and the Kruskal-Wallis test for multiple-group comparisons. Statistical significance was set at $p < 0.05$.

Handling of Missing Data

Missing data accounted for less than 5% of all responses. For continuous variables (knowledge and practice scores), missing values were imputed using mean substitution, and for categorical variables (e.g., demographics), the mode was used. This approach minimizes bias while preserving statistical power, as the proportion of missing data was low and the distribution of continuous variables was approximately normal [17].

Results

A total of 129 general dentists participated in the study, of whom 48.8% (N = 63) were female and 51.2% (N = 66) were male. Most participants (45.7%) had less than five years of work experience, while only 11.6% had more than 20 years of experience. Table 1 shows the demographic characteristics and overall knowledge and practice scores of participants, categorized by gender and years of work experience.

Table 1- Demographic Characteristics and Overall Knowledge and Practice Scores of Participants (N = 129)

Characteristic	Frequency	Percentage (%)	Knowledge Score Mean ± SD	Knowledge level	Practice Score Mean ± SD	Practice level
Gender: Female	63	48.8	5.05 ± 1.20	Moderate	5.50 ± 1.55	Moderate
Gender: Male	66	51.2	4.89 ± 1.31	Moderate	5.28 ± 1.66	Moderate
Experience <5 years	59	45.7	4.92 ± 1.28	Moderate	5.35 ± 1.60	Moderate
Experience 6–10 years	23	17.8	5.00 ± 1.22	Moderate	5.43 ± 1.58	Moderate
Experience 11–15 years	16	12.4	5.06 ± 1.30	Moderate	5.38 ± 1.65	Moderate
Experience 16–20 years	16	12.4	4.94 ± 1.25	Moderate	5.44 ± 1.62	Moderate
Experience >20 years	15	11.6	5.00 ± 1.29	Moderate	5.40 ± 1.64	Moderate

Knowledge Assessment of General Dentists

Table 2 presents the detailed results of the knowledge assessment across 16 items. The highest correct response rate was observed for the critical time for an avulsed tooth (93.8%), while the lowest was for PDL survival in tap water (11.63%). Only 42.64% of participants correctly identified the best storage medium.

Practice Assessment of General Dentists

Table 3 presents the practice assessment results based on 10 items. Only 14.73% of dentists reported having educational materials on avulsion in their clinics, while 91.47% expressed a need for additional knowledge and training on this subject.

Correlation Between Knowledge and Practice, and demographic variables

A moderate positive correlation was observed between knowledge and practice scores ($r = 0.45$, $p < 0.001$), indicating that higher knowledge levels were associated with better clinical practices. No significant associations were found between knowledge scores and gender ($p = 0.42$) or years of experience ($p = 0.43$), and similarly, practice scores were not significantly associated with gender ($p = 0.23$) or years of experience ($p = 0.66$).

Table 2 - Knowledge Assessment of General Dentists Regarding Dental Avulsion Management (N = 129)

Question	Correct (%)	Incorrect (%)
Critical time for avulsed tooth	93.8	6.2
Best storage medium	42.64	57.36
Management of infected avulsed tooth	42.64	57.36
Root canal timing for closed apex	72.09	27.91
Root canal timing when out >60 min	67.44	32.56
Root canal timing for open apex	65.12	34.88
Pre-implantation fluoride soaking	62.79	37.21
Type of intracanal medication	75.19	24.81
PDL survival in tap water	11.63	88.37
Revascularization window for open apex	47.29	52.71
Prevention of external resorption	41.09	58.91
Antibiotic prophylaxis necessity	24.03	75.97
Local anesthesia timing	66.67	33.33
Prognosis of replanted teeth	62.79	37.21
Contraindications for replantation	82.17	17.83
Replantation of primary teeth	88.37	11.63

Table 3 - Practice Assessment of General Dentists Regarding Dental Avulsion Management (N = 129)

Practice Item	Optimal Practice (%)	Suboptimal Practice (%)
Availability of educational materials	14.73	85.27
Following IADT protocol in clinical cases	67.44	32.56
Patient education about avulsion	55.81	44.19
Emergency management readiness	61.24	38.76
Use of appropriate splints	68.22	31.78
Antibiotic prescription adherence	42.64	57.36
Follow-up scheduling after reimplantation	59.69	40.31
Pain management adherence	65.12	34.88
Documentation of traumatic dental injuries	50.39	49.61
Referral to specialists when needed	57.36	42.64

Discussion

This study assessed the knowledge and clinical practices of general dentists in Isfahan regarding dental avulsion management. Overall, the participants demonstrated a moderate level of knowledge and clinical practice, with certain areas showing considerable gaps that could potentially impact patient outcomes**.**

Knowledge of Dental Avulsion Management

Regarding knowledge, most participants correctly identified the critical extra-alveolar time for replantation, consistent with prior studies reporting relatively high awareness of time sensitivity among dental practitioners [6, 18]. However, knowledge about the optimal storage medium for avulsed teeth was limited, with less than half of dentists responding correctly. This finding aligns with previous research in both developing and developed countries, showing that many dentists are unaware of the best storage media, such as Hank's Balanced Salt Solution, which is crucial for maintaining periodontal ligament (PDL) cell viability [19, 20]. Similarly, some knowledge gaps were noted regarding root canal treatment timing and revascularization potential in teeth with open or closed apices, indicating a need for further reinforcement of clinical guidelines.

Clinical Practice Patterns

In terms of clinical practice, discrepancies were observed despite moderate knowledge levels. Approximately one-fourth of participants acknowledged the necessity of antibiotic prophylaxis following reimplantation, consistent with prior evidence suggesting underuse of antibiotics in avulsion cases [6]. Most participants underestimated the detrimental effects of storing avulsed teeth in inappropriate media such as tap water, which is known to cause rapid PDL cell death [18]. Approximately 15% of dentists reported having educational materials, such as brochures or posters, in their clinics, while nearly all participants indicated a desire for additional education. These findings highlight a clear need for structured continuing education programs to improve both theoretical knowledge and practical management skills, as supported by similar studies emphasizing the positive impact of targeted training on dental trauma management [21, 22].

Association with Demographic Factors

The study found no significant differences in knowledge or practice scores based on gender or years of professional experience, suggesting that gaps in knowledge and clinical management are consistent across different demographic groups. This finding indicates that continued clinical exposure alone may not be sufficient for optimal skill acquisition, and underscores the importance of standardized training programs for all general dentists, regardless of their experience level [23].

Limitations and Future Directions

This study had some limitations. As a cross-sectional survey, it relied on self-reported responses, which may be subject to response bias and may not accurately reflect actual clinical behavior. Furthermore, the study was limited to general dentists in Isfahan, which may restrict the generalizability of the results to other regions with different educational backgrounds or clinical exposures. Future research should include longitudinal or interventional studies to evaluate the impact of targeted educational programs on dentists' knowledge, clinical decision-making, and patient outcomes. Additionally, incorporating objective clinical assessments could provide more accurate insights into actual management practices.

Conclusion

General dentists in Isfahan demonstrated a moderate level of knowledge and clinical practice regarding dental avulsion management, with notable gaps in key areas such as optimal storage media, antibiotic prophylaxis, and revascularization considerations. These findings emphasize the need for targeted continuing education programs and the integration of practical guidelines within dental clinics to improve management skills and treatment outcomes for the avulsed teeth.

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Author Contributions: A.M.A.B.B.: Contributed to the conceptualization of the study, designed the methodology. M.A: Developed and validated the software used for data analysis, performed formal analysis, and curated the data.

K.A.: Provided resources, conducted writing review and editing, and created visualizations for the study. H.S.: Supervised the study, managed project administration,
A.N: conducted the investigation, and drafted the original manuscript.

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Ethical Approval Code: This study was approved by the Ethics Committee of the Islamic Azad University of Isfahan (Khorasgan) Branch, Iran. (Approval No. IR.IAU.KHUISF.REC.1403.183).

Informed Consent Statement: All participants provided written informed consent for the anonymous use of their data in this research and its publication, ensuring compliance with ethical guidelines.

Data Availability Statement: The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Conflict of Interest: The authors declare that they have no competing interests.

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Supplementary Material 1 – Questionnaire

Questionnaire: Knowledge and Clinical Practices of General Dentists in Isfahan Regarding Management of Dental Avulsion (2024)

Part 1: Demographic and Professional Information (6 items)

1. Age: …… years
2. Gender: ☐ Male ☐ Female ☐ Prefer not to say
3. Years of clinical experience as a general dentist: ☐ 1–5 years ☐ 6–10 years ☐ 11–15 years ☐ >15 years
4. Main workplace: ☐ Private clinic only ☐ Public clinic/hospital ☐ Both private and public
5. Have you ever received specific training/course on dental trauma management? ☐ Yes ☐ No
6. In the past 5 years, have you participated in any continuing education program that included dental avulsion or trauma? ☐ Yes ☐ No

Part 2: Knowledge about Avulsion Management (16 items – Please choose the single best answer)

1. What is the critical extra-alveolar time beyond which the success rate of reimplantation significantly decreases for a mature permanent tooth? ☐ <15 min ☐ <30 min ☐ <60 min ☐ >60 min
2. Which is the most recommended immediate storage medium for an avulsed tooth? ☐ Tap water ☐ Saliva (in the patient's mouth) ☐ Milk ☐ Hank's Balanced Salt Solution (HBSS)
3. If an avulsed tooth has been kept dry for more than 60 minutes, what is the recommended management before reimplantation? ☐ Immediate reimplantation ☐ Soak in citric acid then fluoride ☐ Remove the necrotic PDL and perform endodontic treatment extra-orally ☐ No reimplantation (extraction)
4. For how long should a flexible splint ideally remain in place after reimplantation of an avulsed permanent tooth? ☐ 1 week ☐ 2 weeks ☐ 4 weeks ☐ 6–8 weeks
5. In case of an avulsed immature permanent tooth (open apex), what is the recommended splinting period? ☐ 1 week ☐ 2 weeks ☐ 4 weeks ☐ >4 weeks
6. Which antibiotic regimen is currently recommended by IADT (2020 update) for avulsion in patients ≥12 years? ☐ Amoxicillin ☐ Doxycycline or Tetracycline ☐ Penicillin V ☐ No systemic antibiotics needed
7. For children under 12 years with avulsed permanent teeth, which antibiotic is preferred? ☐ Tetracycline ☐ Doxycycline ☐ Penicillin or Amoxicillin ☐ Erythromycin
8. When should root canal treatment be initiated for a reimplanted mature permanent tooth with extra-oral dry time <60 min? ☐ Immediately ☐ 7–10 days after reimplantation ☐ After splint removal (2 weeks) ☐ Only if signs of necrosis appear
9. If the avulsed tooth is contaminated with soil or debris, the recommended cleaning method is: ☐ Scrubbing with a toothbrush ☐ Gentle rinsing with saline or tap water ☐ Soaking in sodium hypochlorite ☐ No cleaning needed
10. Is it recommended to remove the blood clot from the socket before reimplantation? ☐ Yes, always ☐ Yes, only if large ☐ No, never ☐ Only in immature teeth
11. What is the recommended storage medium if milk is not immediately available? ☐ Patient's saliva (buccal vestibule) ☐ Normal saline ☐ Tap water ☐ Alcohol
12. In which situation is immediate reimplantation contraindicated? ☐ Cardiac disease requiring antibiotic prophylaxis ☐ Patient unconscious ☐ Severe alveolar fracture compromising socket ☐ Primary tooth avulsion
13. After reimplantation, when should the patient be referred for endodontic treatment if extra-oral dry time was >60 min? ☐ Immediately (extra-oral RCT) ☐ 7–10 days ☐ After 2 weeks ☐ Only if symptoms appear
14. Topical application of tetracycline or doxycycline on the root surface before reimplantation is recommended in: ☐ All mature teeth ☐ Immature teeth with extra-oral time >60 min ☐ All avulsed teeth ☐ Never recommended
15. Which of the following significantly improves the prognosis of reimplanted teeth with prolonged dry time? ☐ Soaking in 2% sodium fluoride for 20 min ☐ Emdogain application ☐ Immediate RCT ☐ None of the above
16. Tetanus prophylaxis should be checked and updated if the avulsed tooth was contaminated and the patient's last booster was >5 years ago. ☐ True ☐ False

Part 3: Clinical Practice and Behavior (10 items)

1. Do you have any educational posters or leaflets about dental trauma/avulsion in your clinic? ☐ Yes ☐ No
2. In the last 2 years, have you personally managed a case of permanent tooth avulsion? ☐ Yes ☐ No ☐ I don't remember

3. If you receive a phone call from a parent about an avulsed tooth, do you instruct them to store the tooth in milk? ☐ Always ☐ Usually ☐ Sometimes ☐ Never
4. Do you keep Hank's Balanced Salt Solution (HBSS) or any commercial tooth preservation solution in your clinic? ☐ Yes ☐ No
5. Do you routinely inform patients/parents about the proper immediate action in case of tooth avulsion? ☐ Yes, all patients ☐ Only pediatric patients ☐ Only when asked ☐ Never
6. In your clinic, is there a written emergency protocol for avulsion management? ☐ Yes ☐ No
7. When you reimplant an avulsed tooth, do you use a flexible splint (e.g., fishing line + composite or wire + composite)? ☐ Always ☐ Usually ☐ Rarely ☐ Never ☐ I don't reimplant
8. Do you prescribe systemic antibiotics after reimplantation of an avulsed permanent tooth? ☐ Always ☐ Usually ☐ Only in contaminated cases ☐ Never
9. Do you schedule a follow-up visit within 7–10 days after reimplantation? ☐ Always ☐ Usually ☐ Sometimes ☐ Never
10. Have you ever referred an avulsion case to a specialist (endodontist/oral surgeon/pediatric dentist) instead of managing it yourself? ☐ Always ☐ Usually ☐ Sometimes ☐ Never

Scoring:

- Knowledge section: 1 point for each correct answer (total 0–16)
- Practice section: 1 point for the most appropriate/desirable answer (as defined by IADT 2020 guidelines)

End of questionnaire – Thank you for your participation!