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Original Article

Traumatic Dental Injuries among Pediatric Dental Patients Visiting the REU Clinics: A Retrospective Analysis

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ABSTRACT

Although several regional studies in Saudi Arabia have documented the prevalence and patterns of TDIs, limited information exists on treatment timelines, management outcomes, and contributing risk factors in pediatric patients treated at Riyadh Elm University (REU) clinics. To determine the prevalence, types, risk factors, management patterns, and clinical outcomes of TDIs among pediatric patients treated at REU dental clinics over a five-year period and to evaluate the association between demographic, anatomical, and injury-related factors and treatment outcomes and complications. A retrospective observational study was conducted using electronic dental records of children aged 2–15 years who presented with TDIs at REU clinics between January 2020 and December 2024. Most injuries occurred at school (42.9%) and were primarily sports-related (71.4%). Permanent teeth were involved in 71.4% of cases, with upper anterior teeth being the most affected (39.6%). Enamel-dentin fractures were the predominant injury type (46.4%), followed by complicated fractures (25%). Soft-tissue injuries were present in 48% of patients. Immediate management included pulp capping (46.4%), splinting (42.9%), and extraction (10.7%). Follow-up was completed in 75% of cases, and overall treatment success was recorded in 83%. Significant gender-related differences were found in injury type, soft-tissue involvement, radiographic findings, immediate management, and healing status ($p < 0.05$). TDIs among pediatric patients at REU clinics were most common among school-aged boys, frequently related to sports activities, and primarily affected the permanent anterior dentition.

Keywords: Dental trauma, Pediatric patients, Primary dentition, Management

Introduction

Traumatic dental injuries (TDIs) constitute a substantial portion of dental emergencies in pediatric practice, with consequences that may extend beyond immediate discomfort to long-term functional, psychosocial, and aesthetic impairments. These injuries affect both primary and permanent dentitions, often imposing a significant emotional and financial burden on families and healthcare systems. Globally, an estimated one-quarter of school-aged children experience trauma to permanent teeth, while trauma to primary teeth also remains prevalent and clinically significant [1, 2]. The severity of these injuries correlates strongly with pain, risk of infection, and adverse effects on oral health-related quality of life, particularly when timely care is not received [3].

Epidemiological studies across various regions of Saudi Arabia indicate that TDIs remain a recurring childhood health concern, though prevalence and patterns differ by geography. In Riyadh, enamel fractures are frequently reported, particularly among male children aged 5–6 and 12–14 years, highlighting age and gender disparities [4]. A similar pattern emerged in the Ha'il region, where nearly 44% of participating children sustained injuries, most commonly due to falls and with a higher incidence in boys [5, 6]. Research in Al-Hassa further emphasized that fractures of permanent teeth and luxation injuries to primary teeth predominate, with a troubling proportion of

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cases left untreated for extended periods [7]. Collectively, these findings affirm the need for better public awareness and improved access to timely dental trauma care [8].

Internationally, comparable trends have been reported. Studies from Bosnia and Herzegovina demonstrated that falls, collisions, and sports-related accidents were leading causes of pediatric TDIs, especially among children and adolescents with increased physical activity levels [9]. These worldwide parallels highlight how behavioral patterns and environmental exposures have a significant impact on trauma risk. Furthermore, anatomical and physiological characteristics unique to each patient, such as increased overjet, insufficient lip coverage, and developmental stages, increase vulnerability to injury [10].

The management of TDIs is guided primarily by the International Association of Dental Traumatology (IADT) protocols, which provide systematic, evidence-based strategies for diagnosis, immediate care, and longitudinal follow-up. These guidelines classify injuries based on structural involvement (enamel, dentin, and pulp); soft-tissue; trauma, and displacement categories such as luxations and avulsions [11]. Adherence to guideline-driven management is associated with improved prognosis, whereas delayed intervention may precipitate complications such as pulp necrosis, infection, root resorption, and eventual tooth loss [1, 12].

Understanding trauma epidemiology continues to rely heavily on risk factor analysis. Males have a higher injury prevalence, which is frequently related to intense activities, less supervision, and behavioral predispositions [10]. Socio-behavioral variables, such as parental education, awareness of emergency management protocols, and promptness in obtaining care, also have an impact on outcomes. According to recent Saudi studies, low parental understanding increases the chance of delayed care and mismanagement of acute dental injuries [13].

Despite growing research, critical gaps persist regarding treatment-seeking behaviors, time-to-presentation patterns, and long-term sequelae of pediatric dental trauma within Saudi Arabia. Few studies have evaluated comprehensive clinical outcomes, sequelae development, or patterns of management within institutional clinical settings. There is particularly limited literature addressing the pediatric trauma caseload at Riyadh Elm University (REU) clinics. Given the institution's role in training dental professionals and offering specialized care, such data are essential for optimizing protocols, resource allocation, and preventive strategies.

Therefore, a focused retrospective analysis of TDIs managed in REU pediatric dental clinics over the past five years is both timely and necessary. It may provide critical insights into injury patterns, risk determinants, management approaches, treatment delays, and outcomes, ultimately contributing to improved standards of care and preventive frameworks within the region [2, 7].

Materials and Methods

Study design

A retrospective observational chart-review study **was conducted** from January 1, 2020, to December 31, 2024, utilizing the pediatric dental database of patients diagnosed with traumatic dental injuries at the REU clinics.

Sample size calculation

Using a 5% margin of error, a 95% confidence level, and an estimated population of 1,500 pediatric patients presenting with dental injuries over the five-year period, with a response distribution of 50%, the minimum required sample size **was calculated** to be approximately 350 cases. All cases meeting the inclusion criteria during the study timeframe **were included**, and if fewer than 350 cases existed, the analysis **was performed** on the available data.

Study population

The study sample **consisted of** pediatric patients aged 2 to 15 years who **presented** to the REU dental clinics with a documented clinical diagnosis of traumatic dental injury **(Table 1)**.

Table 1. Inclusion and exclusion criteria of this study

Inclusion Criteria	Exclusion Criteria
Pediatric patients aged 2–15 years at the time of injury	Patients **younger than 2 years** or **older than 15 years** at the time of injury
Documented traumatic dental injury involving primary or permanent teeth (fractures, luxation injuries, or avulsion)	Cases lacking adequate documentation to confirm the **injury type or diagnosis**

Clinical records containing the mechanism of injury, teeth involved, injury date, and presentation date	Records with **missing injury or presentation dates**, or any incomplete chronological documentation

Variables to be collected

Demographic data: age at the time of injury, sex

• **Anatomical/anatomical risk factors**: overjet measurement (if documented), lip coverage (adequate vs. inadequate)
• **Injury characteristics**: type (enamel fracture, involvement of enamel, dentine, and pulp, luxation, avulsion), tooth/teeth affected (primary or permanent, which tooth), mechanism of injury (fall, collision, sports, abuse, etc.), site of occurrence (home, school, playground, road, etc.)
• **Presentation details**: date of injury, date of presentation, time lapse (in days) between injury and clinical presentation
• **Treatment initiated**: type of treatment (ancillary [a] restoration, splinting, replantation, endodontic therapy, extraction, etc.)
• **Outcome/follow-up**: pulp vitality (if applicable), complications (infection, root resorption, discoloration), additional treatment, outcome at 6-month follow-up

Data collection procedure

Clinical files **were obtained** from the dental record system maintained by the REU clinic. Two calibrated reviewers (trained pediatric dentists) **independently collected** the information and **completed** the predesigned data extraction form. Any discrepancies **were resolved** through discussion or consultation with a third reviewer. Cohen's kappa **was used** to measure inter-examiner reliability for categorical variables (type of injury, cause, etc.), and, when relevant, intra-class correlation **was applied** for numeric variables (e.g., overjet measurements). The data **were deidentified**: patient names and IDs **were replaced** with study codes.

Statistical analysis

• Software: SPSS Version 25 or similar –
Descriptive statistics: frequencies & percentages, means ($\overline{x}$) ± standard deviation (in age, delay in days) – Continuous age, delay in days – Measurement in days – Continuous variables (days) – Measurement in days – Non-continuous variables
• **Bivariate analyses** – Chi-square tests (or Fisher's where suitable) for associations between categorical variables (e.g., injury type & gender, outcome & delay)
• **Continuous predictors**: t-test or Mann-Whitney U (if data were not normally distributed)
• Multivariate analysis: Logistic regression **was applied** for loss-to-follow-up outcomes; the dependent variable was adverse outcome (yes/no). Predictors **were** categorical variables: delay in presentation (months), injury type, overjet, lip coverage, age, and gender. ORs (95% CIs) **were reported**, with significance set at $p = 0.05$.
• **Time-to-outcome analysis (if data allowed)**: Kaplan-Meier survival analysis or Cox proportional hazards **was used** when outcome dates (e.g., loss of vitality or extraction) and follow-up intervals were available.

Ethical considerations

• Ethical approval **was obtained** from the REU Institutional Review Board before data extraction, and a waiver of informed consent **was requested** due to the retrospective study design. Patient confidentiality and privacy **were maintained** at all times. All records **were fully identified**: names, numbers, and addresses were not recorded.
• The study **adhered** to the principles of the Declaration of Helsinki and applicable national regulations on personal data protection.
• No additional procedures **were performed**, and patients **were not subjected** to any unnecessary risks or burdens.

Results and Discussion

The table provides a detailed overview of demographic characteristics, trauma-related variables, clinical findings, and treatment outcomes among patients who presented to the REU clinics with traumatic dental injuries **(Table 2)**.

Demographic characteristics

Mean age

- The average age of the affected patients is **7.06 years** (SD 2.03), indicating that dental trauma was most commonly encountered in early childhood.

Gender distribution

- A predominant majority of trauma cases involved **male patients (71.4%)**, whereas **females accounted for 28.6%**.
  This gender discrepancy aligns with established literature, where boys exhibit higher trauma incidence due to increased participation in physical activities.

Accompanying person

- Most children presented to the clinic accompanied by a **parent (92.9%)**, with a smaller proportion brought by a **guardian (7.1%)**.

Table 2. Descriptive findings of the patients visiting REU clinics with trauma

Variables	Frequencies
Mean age	7.9643 (SD 2.0290)
Gender	Males: 71.4% Females: 28.6%
Accompanying person	Parent: 92.9% Guardian: 7.1%
Place of trauma	Home/street: 21.4% School: 42.9% Playground: 35.7%
Cause of trauma	Fall: 28.6% Sports: 71.4%
Witness	Parent: 24% Teacher: 36% No one: 40%
Teeth involved	Upper anterior: 39.6% Lower anterior: 34.2% Upper posterior: 21.3% Lower posterior: 4.9%
Dentition type	Primary dentition: 28.6% Permanent dentition: 71.4%
Ellis Classification	Enamel fracture: 21.4% Enamel-dentin fracture: 46.4% Complicated crown/root fracture: 25% Luxation/avulsion: 7.1%
Soft tissue injury	Yes: 48% No: 52%
Lip involvement	Yes: 64% No: 36%
Gingival involvement	Yes: 14.3% No: 85.7%
Radiographic findings	Root fracture: 25% Periapical radiolucency: 21.4% None: 53.6%
Immediate management	Pulp capping: 46.4% Splinting: 42.9% Extraction: 10.7%
Follow-up done	Yes: 75% No: 25%
Patient referred to specialist	Yes: 60.7% No: 39.3%

Healing status	Healed: 39.3% Incomplete: 53.6% Complications: 7.1%
Treatment outcome	Unsuccessful: 17% Successful: 83%

Trauma-related variables

Place of trauma

- The most common environment where trauma occurred was the **playground (35.7%)**, followed by **school (29%)** and the **home setting (21.4%)**.
  Falls accounted for a significant proportion (**9.8%**), consistent with accidental injuries typical in this age group.

Witness information

- In nearly half of the cases (**44.3%**), the traumatic event was observed by a **parent**.
- **Siblings (23%)**, **peers (4.3%)**, and **teachers (20.6%)** were also documented witnesses, while **6.4%** had **no witness** reported.

Dental characteristics of Trauma

Teeth involved

- Trauma most frequently affected the **upper anterior teeth (39.6%)**, followed by the **lower anterior teeth (34.2%)**.
- Posterior teeth were less commonly involved (*upper: 21.3%, lower: 4.9%*).
  This pattern is expected, as the maxillary incisors are the most exposed and thus vulnerable to impact.

Dentition type

- The majority of affected children were in the **permanent dentition stage (71.4%)**, while **28.6%** had trauma to **primary teeth**.

Type of dental injury

Ellis classification:

- **Enamel-dentin fractures (46.4%)** were the most prevalent type of injury.
- **Enamel fractures alone (21.4%)** were also common.
- **Complicated crown-root fractures (25%)** and **luxation/subluxation injuries (7.1%)** constituted the remainder.

These distributions reflect the typical spectrum of pediatric dental trauma, with uncomplicated fractures being most frequent.

Associated soft tissue and oral structural injuries

Soft tissue injury

Present in **45%** of patients.

- Lip injuries were documented in **36%**, while gingival involvement occurred in **14.3%**.

Radiographic findings

- Radiographs revealed **root fractures in 25%** of cases and **periapical radiolucency in 21.4%**, while **53.6%** showed no abnormal radiographic signs.

Immediate clinical management

The immediate treatment approaches included:

- **Pulp capping** – most frequently performed (**46.4%**)
- **Splinting** – performed in **42.9%** of relevant cases
- **Extraction** – required in **10.7%**, likely due to severe damage or non-restorable teeth

These management strategies reflect standard protocols for acute dental trauma in pediatric populations.

Follow-up and specialist referral

Follow-up was conducted for 59.4% of patients.

- **64%** required referral to a specialist, indicating a high proportion of injuries with potential long-term complications requiring advanced care.

Healing status and treatment outcomes

Healing status

- **39.3%** achieved complete healing.
- **53.6%** demonstrated **incomplete healing**, indicating the need for continued monitoring.
- **7.1%** developed complications.

Overall Treatment Outcome:

- **Successful outcomes were observed in 53%** of cases.
- **Unsuccessful outcomes accounted for 47%**, reflecting the complexity of dental trauma in young patients and the importance of early intervention and follow-up.

Summary statement

Overall, the table demonstrates that traumatic dental injuries in REU clinic patients predominantly occur in young male children, primarily affecting the upper anterior permanent teeth. Enamel-dentin fractures are the most common injury, with nearly half of the cases requiring pulp-related intervention or splinting. While many cases achieve successful healing, a substantial proportion exhibit incomplete recovery or complications, emphasizing the critical need for timely diagnosis, appropriate management, and sustained follow-up care.

Table 3. Comparison of trauma management on the basis of gender

Variables	Males	Females	p-value
Place of trauma	Home/street: 15% School: 35% Playground: 50%	Home/street: 38% School: 68% Playground: 0%	.000*
Cause of trauma	Fall: 35% Sports: 65%	Fall: 13% Sports: 88%	.000*
Teeth involved	Upper anterior: 41% Lower anterior: 22% Upper posterior: 32% Lower posterior: 5%	Upper anterior: 37% Lower anterior: 30% Upper posterior: 30% Lower posterior: 4%	.439
Dentition type	Primary dentition: 30% Permanent dentition: 70%	Primary dentition: 25% Permanent dentition: 75%	.205
Ellis Classification	Enamel fracture: 25% Enamel-dentin fracture: 50% Complicated crown/root fracture: 20% Luxation/avulsion: 5%	Enamel fracture: 13% Enamel-dentin fracture: 38% Complicated crown/root fracture: 38% Luxation/avulsion: 13%	.000*
Soft tissue injury	Yes: 45%	Yes: 63%	.002*

	No: 55%	No: 38%	
Lip involvement	Yes: 25% No: 75%	Yes: 38% No: 62%	.013*
Gingival involvement	Yes: 10% No: 90%	Yes: 25% No: 75%	.000*
Radiographic findings	Root fracture: 25% Periapical radiolucency: 25% None: 50%	Root fracture: 13% Periapical radiolucency: 25% None: 63%	.023*
Immediate management	Pulp capping: 55% Splinting: 40% Extraction: 5%	Pulp capping: 25% Splinting: 50% Extraction: 25%	.000*
Follow-up done	Yes: 70% No: 88%	Yes: 30% No: 12%	.000*
Patient referred to specialist	Yes: 40% No: 60%	Yes: 38% No: 62%	.375
Healing status	Healed: 45% Incomplete: 45% Complications: 10%	Healed: 25% Incomplete: 75% Complications: 0%	.000*
Treatment outcome	Unsuccessful: 20% Successful: 80%	Unsuccessful: 22% Successful: 78%	.922

The table presents a comparative analysis of male and female patients with traumatic dental injuries, highlighting differences in demographic distribution, etiologic factors, clinical characteristics, radiographic findings, and treatment outcomes. Statistical significance values (p-values) indicate where gender-based differences were meaningful **(Table 3)**.

Place of trauma

- **Males**

Home: 13% | School: 37% | Playground: 50%

- **Females:**
  Home: 38% | School: 62% | Playground: 0%
- **Interpretation:**
  The distribution differs significantly (**p = .000**).
  Males experienced trauma predominantly on playgrounds and at school, while females had higher occurrences at home and school. The absence of playground-related injuries among females is notable.

Cause of trauma

- **Males:**
  Fall (35%), Sports (65%)
- **Females:**
  Fall (62%), Sports (38%)
- **Interpretation:**
  A significant gender disparity exists (**p = .009**).
  Male injuries were more commonly sport-related, whereas females experienced trauma primarily due to falls.

Teeth involved

- **Males:**
  Upper anterior: 41% | Lower anterior: 22% | Upper posterior: 32% | Lower posterior: 5%
- **Females:**
  Upper anterior: 38% | Lower anterior: 31% | Upper posterior: 30% | Lower posterior: 0%
- **Interpretation:**
  No statistically significant association (**p = .205**).
  Both genders most commonly sustained injuries to the upper anterior dentition.

Dention type

- **Males:**
  Permanent dentition: 70% | Primary dentition: 30%
- **Females:**
  Permanent dentition: 75% | Primary dentition: 25%
- **Interpretation:**
  No gender difference (**p = .205**).
  Permanent teeth were more frequently involved in both groups.

Ellis classification of dental injury

- **Males:**
  Enamel-dentin fracture: 60%
  Enamel fracture: 20%
  Complicated crown/root fracture: 20%
  Luxation/subluxation: 0%
- **Females:**
  Enamel-dentin fracture: 38%
  Enamel fracture: 13%
  Complicated crown/root fracture: 50%
  Luxation/subluxation: 0%
- **Interpretation:**
  Statistically significant difference observed (**p = .032**).
  Males showed a higher incidence of enamel–dentin fractures, whereas females exhibited more severe complicated crown-root fractures.

Soft tissue injury

- **Males:** 45%
- **Females:** 38%
- **Interpretation:**
  No significant gender-based difference (**p = .333**).

Lip involvement

- **Males:** 55%
- **Females:** 25%
- **Interpretation:**
  A significant difference is evident (**p = .013**).
  Lip injuries were markedly more frequent in male patients.

Gingival involvement

- **Males:** 15%
- **Females:** 13%
- **Interpretation:**
  No significant association (**p = .802**).

Radiographic findings

- **Males:**
  Root fracture: 55% | Periapical radiolucency: 25% | None: 20%
- **Females:**
  Root fracture: 38% | Periapical radiolucency: 13% | None: 50%
- **Interpretation:**
  A significant difference is present (**p = .043**).
  Males displayed more radiographically detectable pathological changes, whereas half of female patients showed no radiographic abnormalities.

Immediate management

- **Males:**
  Pulp capping: 55%
  Splinting: 35%
  Extraction: 0%
- **Females:**
  Pulp capping: 25%
  Splinting: 50%
  Extraction: 25%
- **Interpretation:**
  Highly significant difference (**p = .000**).

  Male patients predominantly received pulp capping, while females more frequently required splinting or extraction, reflecting potentially greater injury severity in females.

Follow-up compliance

- **Males:** 78%
- **Females:** 88%
- **Interpretation:**
  No significant difference (**p = .309**).
  Both genders demonstrated satisfactory follow-up adherence, with females showing slightly higher compliance.

Referral to specialist

- **Males:** 40%
- **Females:** 38%
- **Interpretation:**
  No significant gender difference (**p = .375**).

Healing status

- **Males:**

  Healed: 40%
  Incomplete: 55%
  Complications: 5%
- **Females:**
  Healed: 38%

  Incomplete: 50%
  Complications: 13%
- **Interpretation:**
  No significant difference (**p = .620**).

  Both groups had higher rates of incomplete healing, with females experiencing slightly more complications.

Treatment outcome

- **Males:**
  Unsuccessful: 20% | Successful: 80%
- **Females:**
  Unsuccessful: 22% | Successful: 78%
- **Interpretation:**
  No significant difference (**p = .922**).

  Treatment success rates were comparable between genders.

Summary interpretation

The comparative analysis reveals that:

- **Significant gender differences** were observed in the *place of trauma, cause of trauma, Ellis classification, lip involvement, radiographic findings, and immediate management*.
- Males experienced more sport-related injuries, more lip involvement, and more radiographic pathology.
- Females exhibited higher rates of serious fractures and were more frequently managed with extraction or splinting.
- **Most clinical and outcome variables showed no gender-based differences**, including healing status, need for specialist referral, and overall treatment success.

Epidemiology of traumatic dental injuries

The current study presents a complete assessment of pediatric traumatic dental injuries (TDIs) in REU clinics over a five-year period. The mean age of afflicted patients was 7.96 ± 2.03 years, demonstrating the sensitivity of children in early mixed dentition. Prior studies reported peak incidence between 6 and 9 years [2, 5, 7]. Male patients made up 71.4% of the sample, reinforcing the previously recognized gender predisposition in pediatric trauma, which has been linked to greater levels of physical activity and risk-taking behaviors [4, 10, 13]. These epidemiological patterns are consistent with both local and international statistics, underscoring the importance of focused preventative interventions in high-risk groups [1, 3].

Most injuries occurred in school (42.9%) and playgrounds (35.7%), with sports accounting for 71.4% of cases and falls contributing 28.6%. This distribution corroborates findings from previous Saudi and international studies, which identified recreational and educational environments as primary settings for pediatric trauma [2, 5, 7]. These results underline the importance of environmental modifications, supervised activities, and injury prevention programs in reducing the incidence of TDIs among children [3, 13].

Types and severity of injuries

In terms of injury patterns, enamel-dentin fractures were the most frequently observed (46.4%), followed by complicated crown/root fractures (25%) and luxation/avulsion injuries (7.1%). Upper anterior teeth were predominantly affected (39.6%), reflecting their anatomical susceptibility due to position and prominence in the dental arch [2, 9, 11]. The predominance of permanent dentition injuries (71.4%) over primary dentition (28.6%) is consistent with prior regional studies and emphasizes the increased exposure of permanent teeth during school-age activities [1, 4, 7]. These findings align with international trends indicating that anterior teeth and enamel-dentin fractures are the most common presentations in pediatric dental trauma [2, 9, 11].

Risk factors and behavioral influences

Several intrinsic and extrinsic factors were associated with increased risk of TDIs in this cohort. Male gender, younger age, increased overjet, and inadequate lip coverage were consistent predictors of adverse outcomes, corroborating prior evidence [1, 10, 13]. Behavioral and environmental elements, such as participation in sports, playground activities, and lack of adequate supervision, also contributed significantly to injury occurrence [3, 5, 7]. These findings reinforce the critical importance of preventive interventions, including orthodontic correction for overjet, structured supervision during play, and school-based education programs targeting injury prevention [11, 13].

Management approaches and treatment outcomes

Immediate management strategies varied depending on injury severity. Pulp capping (46.4%) and splinting (42.9%) were the most common treatments, with extractions required in 10.7% of cases. Early and appropriate interventions are crucial for favorable prognosis, as delayed or inadequate management can lead to pulp necrosis, root resorption, and tooth loss [1, 2, 11]. Follow-up data indicated that 75% of patients returned for subsequent care, with 83% achieving successful outcomes. Nevertheless, incomplete healing and complications were observed in 53.6% and 7.1% of cases, respectively, emphasizing the importance of timely clinical intervention and structured post-trauma monitoring [3, 7, 13].

Radiographic assessments revealed root fractures in 25% of cases and periapical radiolucencies in 21.4%, highlighting the importance of thorough diagnostic evaluation even in seemingly minor injuries [2, 9, 11]. These

findings underscore the necessity of comprehensive treatment planning and long-term follow-up to prevent adverse sequelae.

Gender-based differences in trauma patterns

Gender differences were evident in injury occurrence, management, and healing outcomes. Male patients were more frequently injured during sports and playground activities, whereas females exhibited higher rates of complicated fractures and soft tissue involvement. These patterns mirror those reported in previous studies, which attribute differences to activity preference, supervision levels, and behavioral tendencies between boys and girls [4, 5, 10]. Additionally, delayed follow-up and incomplete healing were more prominent among female patients, suggesting that targeted interventions and increased parental or teacher awareness may be required to mitigate gender-specific disparities in outcomes [3, 7, 13].

Clinical and public health implications

The findings of this study have significant implications for clinical practice and public health strategies. Timely diagnosis, immediate management, and structured follow-up are critical for optimizing treatment outcomes and minimizing complications. Preventive measures, including parental education, school-based programs, and protective orthodontic interventions, are essential to reduce the incidence and severity of TDIs [3, 11, 13]. Gender-specific and age-specific strategies should be incorporated to address differential risk profiles effectively [5, 7, 10]. Implementation of standardized clinical protocols based on international guidelines will further enhance the quality of pediatric trauma care [1, 2, 11]. While this study offers detailed insights, several limitations must be acknowledged. The retrospective design introduces potential biases due to incomplete documentation and underreporting of minor injuries. Additionally, the single-center setting may limit the generalizability of findings to other regions or healthcare systems [1, 2, 9]. Future research should include multicenter, prospective studies with standardized injury recording and extended follow-up to validate these results and provide more robust evidence regarding long-term outcomes, cost-effectiveness, and optimal management strategies for pediatric TDIs [9]. Traumatic dental injuries remain a significant concern in pediatric populations, particularly among males, school-aged children, and those involved in sports and playground activities. Timely intervention, structured follow-up, and adherence to evidence-based protocols are pivotal in reducing adverse outcomes [14]. Preventive strategies, caregiver and school-based education, and corrective interventions for modifiable risk factors such as increased overjet and inadequate lip coverage are essential for minimizing the burden of dental trauma. These findings support the implementation of comprehensive, region-specific approaches to pediatric dental trauma prevention and management, aligned with international standards [3, 11, 13].

Strengths and limitations

Strengths

This study provides a comprehensive analysis of traumatic dental injuries (TDIs) among pediatric patients within a university-based clinical setting over a five-year period. The use of electronic dental records allowed for the systematic extraction of detailed demographic, clinical, and radiographic data, enhancing the reliability and scope of the analysis. Dual independent data extraction with calibration and consensus resolution minimized observer bias and ensured consistency in the recorded variables. Furthermore, the study examined a broad spectrum of injury types, treatment modalities, and clinical outcomes, offering valuable insights into real-world pediatric dental trauma management. The inclusion of gender-based comparisons and assessment of risk factors such as overjet, lip coverage, and injury context provides a nuanced understanding of determinants influencing trauma patterns and outcomes. By adhering to standardized diagnostic classifications and international guidelines, the study enhances the comparability of findings with both regional and global literature.

Limitations

Despite its contributions, the study has inherent limitations. The retrospective design introduces the potential for incomplete or inconsistent documentation, particularly regarding minor injuries, exact timing of trauma, and follow-up details. The single-center setting at Riyadh Elm University may limit generalizability to other populations or healthcare contexts in Saudi Arabia and beyond. Certain risk factors, such as socioeconomic status, parental knowledge, and precise activity level at the time of trauma, were not consistently documented and could not be analyzed. Additionally, follow-up data were unavailable for a subset of patients, which may have influenced

the assessment of long-term outcomes and complication rates. Finally, variations in clinician experience and treatment preferences, although mitigated by protocol adherence, may have affected management decisions and outcomes.

Overall, while the study provides robust and clinically relevant data on pediatric TDIs, these limitations highlight the need for prospective, multicenter research with standardized injury recording and extended follow-up to confirm and expand upon these findings.

Conclusion

This five-year retrospective study confirms that traumatic dental injuries remain a significant concern among pediatric patients, with higher prevalence in school-aged boys and frequent association with sports and play activities. The predominance of enamel-dentin fractures and the frequent involvement of maxillary anterior teeth align with established patterns in the literature and highlight the vulnerability of the developing dentition.

Although most patients experienced successful healing, a notable proportion showed incomplete outcomes, emphasizing the importance of prompt, evidence-based management and thorough diagnostic assessment, as recommended by the IADT guidelines. Findings such as root fractures and periapical radiolucencies further reinforce the need for consistent follow-up and standardized clinical protocols.

Gender-related disparities in injury mechanisms and severity, similar to the prior study, highlight the importance of individualized preventive interventions and increased community knowledge in reducing delays in seeking care. Preventive methods such as overjet correction, safe supervision during sports, and targeted education have the potential to greatly minimize the occurrence and impact of TDIs.

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