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## Evaluation of Dental Luxation Traumas in Turkish Western Mediterranean Population between 1999 and 2017: A Retrospective Study

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**ORIGINAL ARTICLE**

## **Evaluation of Dental Luxation Traumas in Turkish Western Mediterranean Population between 1999 and 2017: A Retrospective Study**

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### **ABSTRACT**

Luxation cases reportedly occur more frequently in men than in women, and the frequency decreases with increasing age. It is important to know the characteristics of luxation injuries to take preventive measures and early treatments. **Objective:** This study aimed to evaluate luxation trauma cases in the Turkish population in the West Mediterranean region between 1999 and 2017. **Methods:** An 18-year retrospective analysis of records of patients with luxation traumas was performed. Data regarding age groups, gender, trauma types, etiologic factors, trauma locations, number of affected teeth, trauma types with/without crown fracture, and time elapsed from trauma onset until clinic visit were determined. Acquired data were tabulated as numbers and percentages. **Results:** A total of 1597 teeth, from 885 patients, exposed to luxation trauma were included. The number of injured teeth per child was 1.8, and single tooth trauma was the most common type. The number of trauma patient was higher in the 0–5 age group, and the number of cases was higher in the primary teeth of the 0–3 age group and in the permanent teeth of the 8–12 age group. The maxillary central incisors were the most commonly affected teeth, and the most common cause was falls. The luxation types most frequently presenting with crown fracture were lateral luxation in the primary teeth (60%) and subluxation in the permanent teeth (33.9%). The proportion of patients with avulsion was the lowest among those visiting the clinic within 2 days of trauma. **Conclusion:** This study revealed that almost half of the trauma patients have a history of luxation trauma. Educational programs for the community regarding causes and prevention of luxation traumas should be continued.

**Key words:** child, dental trauma, injuries, luxation traumas

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### **INTRODUCTION**

Luxation injuries that involved supporting structures and teeth include concussion, subluxation, lateral luxation, intrusion, extrusion, and avulsion.<sup>1</sup> Luxation traumas were reported to account for 15%–61% of all traumas and frequently (38%–43.3%) occur in children between age 6 and 16.<sup>2-9</sup>

Studies have shown that luxation injuries occur in 61.3%–85% of the primary teeth and 22.7%–33.9% of the permanent teeth.<sup>4,10-13</sup> Reduced mineralized bone structure and wide bone marrow areas cause luxation injuries more frequently during the primary dentition period, correlating with the relative strength of the alveolar bone and the supporting structures.<sup>6,12</sup> In contrast, traumas that occur during the permanent

dentition period more generally result in crown fractures.<sup>14-16</sup> Luxation cases reportedly occur more frequently in men than in women, and the frequency decreases with increasing age.<sup>17</sup> While falls is the most frequently observed etiological factor related to luxation traumas during both dentition periods,<sup>11,12,17,18</sup> the most affected teeth are the upper incisors.<sup>9,11,16</sup>

Early intervention and long follow-up periods are important since luxation injuries are frequently observed during periods of growth and development. Parents may generally neglect trauma events during the primary dentition period since families place less importance on the primary teeth, and trauma is more difficult to manage because of the child's age.<sup>19</sup> Other studies have indicated that children exposed to luxation traumas together with soft tissue injuries are

brought to the clinic more frequently and quickly than children with crown fractures, since they generally tend to bleed and suffer from occlusion disorder and eating difficulty.<sup>20-23</sup>

This study highlighted the importance of knowing the characteristics of luxation injuries to take preventive measures and early treatments. Generally, these characteristics have been included in short-term studies; however, the data presented herein are valuable as it represent 18 years of clinical experience. This retrospective study aimed to determine the rate of luxation injuries among dental trauma cases that occurred over an 18-year period in addition to evaluating data on etiologic factors, trauma locations, number of affected teeth, time elapsed from trauma onset until clinic visit, as well as demographic data.

## METHODS

This study was approved by the Suleyman Demirel University Faculty of Medicine Clinical Studies Ethics Council (approval number: 2018/29).

In this study, patients with luxation trauma were selected from among 2116 patients aged 0–18 who attended the clinic from 1999 to 2017 for a dental trauma. Data collected from patient files included patient demographics, trauma location, cause of trauma, time elapsed from trauma onset until clinic visit, and the number of affected teeth. Luxation traumas were classified into two subgroups, as primary and permanent teeth, according to the classification by Andreasen et al.<sup>6</sup> Patients were classified into four age groups (0–5, 6–7, 8–12, and 13–18) according to primary/mixed and permanent dentition periods. The 6–7 year age group was considered as one group since root resorptions of the primary teeth are high at this time, and it constitutes the beginning of root development for permanent teeth.

Trauma locations (streets, home, school, park, pool, and others), causes of trauma (collisions, falls, bicycle, football, basketball, traffic accident, motorcycle accident, violence), and the time from trauma onset until clinic visit (same day, 24–48 h, 3–7 days, 8–14 days, 15 days to 1 month, 2–11 months, >1 year) were classified. The distributions of the primary and permanent teeth affected by luxation traumas along with the number of affected teeth were classified into groups. Luxation trauma types with crown fractures were also determined.

All statistical evaluations were carried out using Statistical Package for Social Science software version 12 (SPSS Inc., Chicago, IL, USA). The percentage for

**Table 1.** Distribution of patients according to gender and age groups

Age groups	Female	Male	Total
	N (%)	N (%)	N (%)
0 – 5	128 (38.3)	215 (39.0)	343 (38.8)
6 – 7	72 (21.6)	79 (14.3)	151 (17.1)
8 – 12	116 (34.7)	165 (29.9)	281 (31.8)
13 – 18	18 (5.4)	92 (16.7)	110 (12.4)
<b>Total</b>	<b>334 (100.0)</b>	<b>551 (100.0)</b>	<b>885 (100.0)</b>

each variable was determined. Chi-square test was used for statistical analysis. Variables with *p* values < 0.05 were considered statistically significant.

## RESULTS

Patients with good quality radiographs and no missing data in their files were determined after evaluating the records of 2116 patients who attended the clinic with dental injury during a period of 18 years. Finally, data from 1971 patients were included in the study. Of the 1971 patients selected, 885 patients (44.9%) with luxation trauma were included in the evaluation. A total of 1597 teeth (746 primary, 851 permanent) exposed to trauma were included in the study from among the 885 patients (334 girls, 551 boys; mean, 1.8 teeth per patient). Overall, the average patient age was  $7.20 \pm 0.14$  (girls,  $6.63 \pm 0.19$ ; boys,  $7.57 \pm 0.19$ ). Luxation injuries occurred more often in boys. Table 1 shows the distribution of the patient age groups according to gender. The relationship between them was statistically significant ( $\chi^2: 29.270, p = 0.000$ ).

Luxation traumas occurred more frequently in the permanent teeth. Lateral luxation injuries were observed most frequently in the primary (43.4%) and permanent teeth (27.1%). When evaluated according to gender, lateral luxation traumas occurred most frequently in the primary teeth of both girls (41.9%) and boys (44.2%). Even though lateral luxation traumas were followed by subluxation and avulsion traumas in the permanent teeth of girls (24.8% and 18.7%), the order after subluxation traumas was lateral luxation and avulsion injuries in boys (25.9% and 24.3%) (Table 2).

Luxation trauma cases were observed most frequently in children in the mixed dentition group (aged 8–12) (57.7%). Luxation traumas in the primary teeth occurred most frequently in the 0–3 years age group (53.9%). While lateral luxation traumas in the 0–3 years age group were followed by intrusion and

**Table 2.** Distribution of luxation trauma types in primary and permanent teeth according to gender (number of teeth)

Luxation trauma types	Female		Male		Total	
	Primary	Permanent	Primary	Permanent	Primary	Permanent
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Concussion	8 (2.7)	27 (8.2)	28 (5.9)	30 (5.4)	36 (4.7)	57 (6.4)
Subluxation	52 (17.9)	82 (24.8)	85 (17.8)	145 (26.1)	137 (17.8)	227 (25.6)
Luxation	122 (41.9)	96 (29.0)	211 (44.2)	144 (25.9)	333 (43.4)	240 (27.1)
Întrusion	55 (18.9)	35 (10.6)	85 (17.8)	48 (8.6)	140 (18.2)	83 (9.4)
Extrusion	16 (5.5)	29 (8.8)	17 (3.6)	54 (9.7)	33 (4.3)	83 (9.4)
Avulsion	38 (13.1)	62 (18.7)	51 (10.7)	135 (24.3)	89 (11.6)	197 (22.2)
Total	291(100.0)	331(100.0)	477(100.0)	556(100.0)	768(100.0)	887(100.0)

\* Teeth with different types of trauma are shown in each group.

**Table 3.** Distribution of luxation trauma types in primary and permanent teeth according to age groups (number of teeth)

Luxation trauma types	0-3	4-5	6-7		8-12	13-18	Total	
	Primary	Primary	Primary	Permanent	Permanent	Permanent	Primary	Permanent
	N(%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Concussion	19 (4.6)	13 (6.1)	4 (2.8)	10 (6.0)	41 (8.0)	6 (2.9)	36 (4.7)	57 (6.4)
Subluxation	73 (17.6)	40 (18.8)	24 (17.0)	54 (32.1)	119 (23.2)	54 (26.1)	137 (17.8)	227 (25.6)
L. Luxation	160 (38.6)	99 (46.5)	74 (52.5)	38 (22.6)	145 (28.3)	57 (27.5)	333 (43.4)	240 (27.1)
Întrusion	98 (23.7)	24 (11.3)	18 (12.8)	22 (13.1)	52 (10.2)	9 (4.3)	140 (18.2)	83 (9.4)
Extrusion	19 (4.6)	10 (4.7)	4 (2.8)	19 (11.3)	45 (8.8)	19 (9.2)	33 (4.3)	83 (9.4)
Avulsion	45 (10.9)	27 (12.7)	17 (12.1)	25 (14.9)	110 (21.5)	62 (30.0)	89 (11.6)	197 (22.2)
Total	414 (100.0)	213 (100.0)	141 (100.0)	168 (100.0)	512 (100.0)	207 (100.0)	768 (100.0)	887 (100.0)

\* Teeth with different types of trauma are shown in each group.

subluxation traumas, lateral luxation traumas were followed by subluxation and avulsion traumas in the 4–5 years age group. The order of luxation trauma type in the 8–12 years age group was similar to that in the 4–5 years age group, whereas avulsion cases became much more frequent, especially after age 12 (Table 3).

Luxation injuries in the primary teeth occurred mostly at home (51.6%), while luxation traumas in the permanent teeth occurred mostly on the streets (51.1%). Of the traumas that occurred at school, 23.3% caused avulsion injuries in the primary teeth and 16.3% in the permanent teeth. Lateral luxation traumas occurred most frequently in parks (primary, 51.3%; permanent, 48.2%) (Table 4).

Luxation traumas in primary and permanent teeth occurred most frequently due to falls (primary, 51.7%; permanent, 40.4%). Traumas due to sports activities, vehicle use, and violence occurred more frequently in the permanent teeth than in the primary teeth. Permanent teeth traumas due to traffic and bicycle accidents resulted most frequently in avulsion injuries (43.8%

and 29.4%, respectively), while they resulted most frequently in lateral luxation traumas in the primary teeth (71.4% and 43.5%, respectively) (Table 5).

When the distributions of the affected teeth were considered, primary and permanent upper central incisors were affected most from luxation injuries. Upper incisors made up 82.8% and 89.3% of the permanent and primary teeth, respectively, affected by luxation traumas (Table 6).

The number of patients with only one tooth affected by luxation traumas was higher (44.8%). The number of individuals with two teeth injured following bicycle accidents was higher, which make up 14.8% of all luxation traumas (41.2%). In 35.3% of the patients exposed to trauma due to traffic accidents,  $\geq 3$  teeth were affected. There were no trauma cases related to basketball and football accidents in which  $> 3$  teeth were affected (Table 7).

In evaluating the number of affected teeth according to age,  $\geq 3$  teeth were affected by luxation traumas in

**Table 4.** Distribution of luxation trauma types according to trauma locations (number of teeth)

Trauma locations	Concussion		Subluxation		L. Luxation		Intrusion		Extrusion		Avulsion		Total	
	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)
Home	13 (36.1)	7 (12.3)	78 (56.9)	26 (11.5)	175 (52.6)	29 (12.1)	82 (58.6)	12 (14.5)	16 (48.5)	7 (8.4)	32 (36.0)	11 (5.6)	396 (51.6)	92 (10.4)
Street	15 (41.7)	26 (45.6)	43 (31.4)	96 (42.3)	93 (27.9)	109 (45.4)	39 (27.9)	41 (49.4)	13 (39.4)	49 (59.0)	38 (42.7)	132 (67.0)	241 (31.4)	453 (51.1)
School	3 (8.3)	21 (36.8)	3 (2.2)	88 (38.8)	22 (6.6)	72 (30.0)	5 (3.6)	20 (24.1)	0 (0.0)	25 (30.1)	10 (11.2)	44 (22.3)	43 (5.6)	270 (30.4)
Park	1 (2.8)	3 (5.3)	13 (9.5)	11 (4.8)	39 (11.7)	26 (10.8)	11 (7.9)	6 (7.2)	4 (12.1)	2 (2.4)	8 (9.0)	6 (3.0)	76 (9.9)	54 (6.1)
Pool	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.3)	1 (0.3)	1 (0.4)	0 (0.0)	3 (3.6)	0 (0.0)	0 (0.0)	0 (0.0)	3 (1.5)	1 (0.1)	10 (1.1)
Others	4 (11.1)	0 (0.0)	0 (0.0)	3 (1.3)	3 (0.9)	3 (1.3)	3 (2.1)	1 (1.2)	0 (0.0)	0 (0.0)	1 (1.1)	1 (0.5)	11 (1.4)	8 (0.9)
Total	36 (100.0)	57 (100.0)	137 (100.0)	227 (100.0)	333 (100.0)	240 (100.0)	140 (100.0)	83 (100.0)	33 (100.0)	83 (100.0)	89 (100.0)	197 (100.0)	768 (100.0)	887 (100.0)

x Teeth with different types of trauma are shown in each group.

**Table 5.** Distribution of luxation trauma types according to trauma etiologic factors (number of teeth)

Etiologic Factors	Concussion		Subluxation		L. Luxation		Intrusion		Extrusion		Avulsion		Total	
	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)	Primary N (%)	Permanent N (%)
Collisions	15 (41.7)	17 (29.8)	61 (44.5)	66 (29.1)	122 (36.6)	49 (20.4)	57 (40.7)	19 (22.9)	7 (21.2)	27 (32.5)	23 (25.8)	32 (16.2)	285 (37.1)	211 (23.8)
Falls	17 (47.2)	22 (38.6)	61 (44.5)	80 (35.2)	175 (52.6)	114 (47.5)	66 (47.1)	43 (51.8)	23 (69.7)	31 (37.3)	55 (61.8)	75 (38.1)	397 (51.7)	358 (40.4)
Bicycle	4 (11.1)	13 (22.8)	12 (8.8)	41 (18.1)	30 (9.0)	46 (19.2)	10 (7.1)	9 (10.8)	3 (9.1)	17 (20.5)	10 (11.2)	55 (27.9)	69 (9.0)	187 (21.1)
Basketball	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.9)	1 (0.3)	3 (1.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (1.2)	0 (0.0)	0 (0.0)	1 (0.1)	6 (0.7)
Football	0 (0.0)	3 (5.3)	0 (0.0)	4 (1.8)	0 (0.0)	6 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	2 (2.4)	0 (0.0)	2 (1.0)	0 (0.0)	17 (1.9)
Traffic accident	0 (0.0)	1 (1.8)	0 (0.0)	15 (6.6)	5 (1.5)	10 (4.2)	1 (0.7)	8 (9.6)	0 (0.0)	2 (2.4)	1 (1.1)	28 (14.2)	7 (0.9)	64 (7.2)
Motorcycle	0 (0.0)	0 (0.0)	1 (0.7)	7 (3.1)	0 (0.0)	6 (2.5)	2 (1.4)	2 (2.4)	0 (0.0)	2 (2.4)	0 (0.0)	4 (2.0)	3 (0.4)	21 (2.4)
Violence	0 (0.0)	1 (1.8)	2 (1.5)	12 (5.3)	0 (0.0)	6 (2.5)	4 (2.9)	2 (2.4)	0 (0.0)	1 (1.2)	0 (0.0)	1 (0.5)	6 (0.8)	23 (2.6)
Total	36 (100.0)	57 (100.0)	137 (100.0)	227 (100.0)	333 (100.0)	240 (100.0)	140 (100.0)	83 (100.0)	33 (100.0)	83 (100.0)	89 (100.0)	197 (100.0)	768 (100.0)	887 (100.0)

**Table 6.** Distribution of the primary and permanent teeth affected by trauma

Permanent	Upper	Lower	Primary	Upper	Lower
	N (%)	N (%)		N (%)	N (%)
Central	564 (79.1)	94 (68.1)	Central	522 (76.9)	45 (67.2)
Lateral	141 (19.8)	37 (26.8)	Lateral	144 (21.2)	17 (25.4)
Canine	6 (0.8)	2 (1.4)	Canine	12 (1.8)	3 (4.5)
Premolar	2 (0.3)	3 (2.2)	1st molars	1 (0.1)	2 (3.0)
Molar	0 (0.0)	2 (1.4)	2nd molars	0 (0.0)	0 (0.0)
Total	713 (100.0)	138 (100.0)	Total	679 (100.0)	67 (100.0)

**Table 7.** Distribution of the trauma etiologic factors and the number of teeth affected from traumas (number of individuals)

Etiologic factors	1	2	3	4	5-7	Total
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Collisions	127 (32.1)	101 (29.0)	20 (26.7)	21 (36.8)	0 (0.0)	269 (30.4)
Falls	184 (46.5)	170 (48.9)	33 (44.0)	19 (33.3)	5 (55.6)	411 (46.4)
Bicycle	53 (13.4)	54 (15.5)	12 (16.0)	10 (17.5)	2 (22.2)	131 (14.8)
Basketball	3 (0.8)	2 (0.6)	0 (0.0)	0 (0.0)	0 (0.0)	5 (0.6)
Football	4 (1.0)	5 (1.4)	1 (1.3)	0 (0.0)	0 (0.0)	10 (1.1)
Traffic accident	16 (4.0)	6 (1.7)	7 (9.3)	4 (7.0)	1 (11.1)	34 (3.8)
Motorcycle	2 (0.5)	3 (0.9)	2 (2.7)	1 (1.8)	1 (11.1)	9 (1.0)
Violence	7 (1.8)	7 (2.0)	0 (0.0)	2 (3.5)	0 (0.0)	16 (1.8)
Total	396 (100.0)	348 (100.0)	75 (100.0)	57 (100.0)	9 (100.0)	885 (100.0)

**Table 8.** Distribution for luxation trauma types with/without crown fracture (number of teeth)

Luxation trauma types	With crown fracture		Without crown fracture		Total	
	Primary	Permanent	Primary	Permanent	Primary	Permanent
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Concussion	0 (0.0)	10 (5.8)	36 (4.8)	47 (6.6)	36 (4.7)	57 (6.4)
Subluxation	6 (24.0)	58 (33.9)	131 (17.6)	169 (24.0)	137 (17.8)	227 (25.6)
L. Luxation	15 (60.0)	38 (22.2)	318 (42.8)	202 (28.0)	333 (43.4)	240 (27.1)
Intrusion	2 (8.0)	19 (11.1)	138 (18.6)	64 (8.9)	140 (18.2)	83 (9.4)
Extrusion	0 (0.0)	12 (7.0)	33 (4.4)	71 (9.9)	33 (4.3)	83 (9.4)
Avulsion	2 (8.0)	34 (19.9)	87 (11.7)	163 (23.0)	89 (11.6)	197 (22.2)
Total	25 (100.0)	171 (100.0)	743 (100.0)	716 (100.0)	768 (100.0)	887 (100.0)

14.3% of the children in the 0–5 years age group and that the number of patients (with ≥3 teeth affected) increased with age (14.6% for the 8–12 age group, 20.9% for the 13–18 age group).

Lateral luxation trauma involved the highest number of primary teeth with crown fractures, while the same was true subluxation traumas in the permanent teeth (Table 8).

Crown fractures accompanied the traumas in 21.5% and 28.2% of the bicycle accident and traffic accident-related luxation trauma cases, respectively. Traumas were related with bicycle and traffic accidents in 58% of cases with crown fracture accompanying extrusion trauma, 52.8% for avulsion, 23.8% for intrusion, and

18.9% for lateral luxation. Evaluation according to age groups revealed that the frequency of crown fractures accompanied with luxation traumas increased with age (8.3% for the 6–7 years age group, 20.3% for the 8–12 years age group, and 25.6% for the 13–18 years age group).

Among cases with trauma in the permanent and primary teeth, 63.1% (extrusion 77.1%, lateral luxation 67.9%, subluxation 67.4%, intrusion 66.3%, concussion 61.4%, avulsion 45.7%) and 68.8% (concussion 75%, subluxation 73.7%, lateral luxation 69.4%, intrusion 67.1%, extrusion 66.7%, avulsion 59.6%), respectively, visited the clinic during the first 2 days after the trauma. The proportion of patients with avulsion trauma in the primary and permanent teeth

**Table 9.** Distribution of luxation trauma types according to time elapsed from trauma onset to clinic visit (number of teeth)

Time	Concussion		Subluxation		L. Luxation		Intrusion		Extrusion		Avulsion		Total	
	Primary	Permanent	Primary	Permanent	Primary	Permanent	Primary	Permanent	Primary	Permanent	Primary	Permanent	Primary	Permanent
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Same day	9 (25.0)	7 (12.3)	35 (25.5)	61 (26.9)	75 (22.5)	66 (27.5)	20 (14.3)	27 (32.5)	11 (33.3)	25 (30.1)	22 (24.7)	34 (17.3)	172 (22.4)	220 (24.8)
24-48 h	18 (50.0)	28 (49.1)	66 (48.2)	92 (40.5)	156 (46.8)	97 (40.4)	74 (52.9)	28 (33.7)	11 (33.3)	39 (47.0)	31 (34.8)	56 (28.4)	356 (46.4)	340 (38.3)
3-7 days	9 (25.0)	22 (38.6)	22 (16.1)	44 (19.4)	66 (19.8)	47 (19.6)	31 (22.1)	17 (20.5)	6 (18.2)	10 (12.0)	17 (19.1)	30 (15.2)	151 (19.7)	170 (19.2)
8-14 days	0 (0.0)	0 (0.0)	11 (8.0)	24 (10.6)	12 (3.6)	18 (7.5)	4 (2.9)	5 (6.0)	3 (9.1)	6 (7.2)	5 (5.6)	13 (6.6)	35 (4.6)	66 (7.4)
15 days-1 month	0 (0.0)	0 (0.0)	3 (2.2)	6 (2.6)	8 (2.4)	8 (3.3)	2 (1.4)	3 (3.6)	2 (6.1)	1 (1.2)	3 (3.4)	13 (6.6)	18 (2.3)	31 (3.5)
2-11 months	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	16 (4.8)	4 (1.7)	1 (0.7)	1 (1.2)	0 (0.0)	2 (2.4)	5 (5.6)	25 (12.7)	22 (2.9)	32 (3.6)
≥ 1 year	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	8 (5.7)	2 (2.4)	0 (0.0)	0 (0.0)	6 (6.7)	26 (13.2)	14 (1.8)	28 (3.2)
Total	0 (0.0)	57 (100.0)	137 (100.0)	227 (100.0)	333 (100.0)	240 (100.0)	140 (100.0)	83 (100.0)	33 (100.0)	83 (100.0)	89 (100.0)	197 (100.0)	768 (100.0)	887 (100.0)
	36 (100.0)													

who were treated in the clinic within two days after the trauma was the lowest. We found that 13.2% of the trauma cases with avulsion trauma in the permanent teeth attended the clinic 1 year or longer after trauma (Table 9).

## DISCUSSION

Since luxation traumas observed in the pediatric population require long follow-up periods and they are among injury types that may be observed as sequelae in the permanent teeth, it is important to understand the factors related to such injuries. Few studies are examining the parameters related to luxation traumas in primary and permanent teeth over an extended time interval.<sup>17,18,24,25</sup>

Luxation traumas were observed more frequently in boys than in girls because of their more frequent participation in physical activities.<sup>18,26-28</sup> On the contrary, some studies indicated the absence of minimal gender-related differences with regard to children in the primary dentition period exposed to the same risk factors (games played, sports, etc.).<sup>9,17,29,30</sup> Boys are at risk to more luxation traumas both during the primary and permanent dentition periods.

The prevalence of luxation traumas was observed to decrease with increasing age, as supported by previous studies.<sup>17,25,31</sup> This prevalence was determined when luxation traumas were evaluated according to age groups, as they were followed by intrusion injuries in the 0–3 year age group. Similarly, researchers indicated that intrusion traumas were most frequently observed at age 2–4 when the physical activities of the children start to increase.<sup>5,32,33</sup> Subluxation traumas occur most frequently at age 6–7 years when the mixed dentition period starts with increasing root resorption in the primary teeth and eruption in the permanent teeth. The order of prevalence for traumas in the permanent teeth in the 8–12 year age group was lateral luxation, subluxation, and then avulsion. This was observed based on the degree of root development of the permanent teeth, their periodontium, and bone structural characteristics. Avulsion injuries were more frequent in the 13–18 years age group, which increased during traumas sustained following bicycle and traffic accidents.

Studies on different age groups more frequently observed subluxation,<sup>2,18,21,23</sup> lateral luxation,<sup>34</sup> and intrusion<sup>30,35</sup> traumas. The most frequent luxation trauma type was lateral luxation, followed by intrusion and subluxation traumas. All these traumas were followed by avulsion traumas in the primary teeth. Studies have presented that avulsion injuries make up

4.6%–10.16% of all traumas and that their prevalence in primary teeth varies between 7.4 and 29.41%.<sup>6,11-14,17,27,36-38</sup> The same researchers reported 0.5%–34% for avulsion traumas in the permanent teeth. In our study, the avulsion trauma rates in the primary and permanent teeth were 11.6% and 22.2%, respectively.

Preschool children are known to spend time mostly at home, while school-aged children spend their time playing games outdoors. Accordingly, luxation traumas in the primary teeth took place most often at home,<sup>30,39</sup> while luxation traumas in the permanent teeth occurred mostly outdoors.<sup>28</sup> The results of our study were similar to those of previous studies. Approximately 10% of traumas observed in the primary teeth occurred in parks. Since the children in this age group spend the majority of their time at home, 51.6% of primary teeth traumas occurred at home. A high proportion of traumas in parks may be due to the moderate climate conditions.

Knowledge of trauma-related etiologic factors plays an important role in the application of protective measures that will reduce the number of trauma cases. As has been stated in many trauma-related studies,<sup>5,17,18,21,26,28,32,35</sup> falls were reported as the most common etiological factor for both permanent and primary teeth. Various studies have reported bicycle accidents as the most common etiological factor of traumas.<sup>25,40,41</sup> Since the participants of these studies were comprised mostly of older children, this may occur because they ride bicycles more frequently and on the road with intense traffic. In the present study, the rate of traffic accident-related trauma did not reach even 1% for the primary teeth, while it exceeded 7% for the permanent teeth. The possible reason for such a higher percentage is that older children do not fasten their safety belts. Indeed, a study conducted in Thailand on 6–14 year age group reported that luxation traumas were not observed in these children when they were obligated to fasten safety belts and to obey this rule.<sup>18</sup> These ratios change from country to country, and different results may be observed depending on geographical conditions and climate-based traumas. While traffic accident-related luxation traumas were observed more frequently in children aged 1–15 years in Eastern Turkey,<sup>42</sup> we found that traffic accident-related traumas resulted more frequently in avulsion injuries in the permanent teeth.

Evaluations of the teeth affected by luxation traumas on children within different age groups revealed that the upper central incisors were more affected by luxation traumas.<sup>2, 5,12,18,27,32,33,35,41,43</sup> This is an expected outcome when the position of the upper incisors (more protruded than lower incisors) is taken into consideration.



Published studies reported that trauma cases related to bicycle and traffic accidents result in injury of more than one tooth.<sup>18</sup> Contrary to this finding, researchers emphasize that, generally, only one tooth is affected in luxation traumas.<sup>5,23,32</sup> This was also confirmed in our study that one tooth has been affected more frequently. Moreover, the number of patients with  $\geq 3$  teeth affected by luxation traumas increased with age, i.e., 14.3% for children in the 0–5 age group. However, another study reported that no cases were observed in the primary dentition period in which  $\geq 3$  teeth were affected.<sup>44</sup> On evaluation of avulsion injuries, a single tooth was affected most frequently.<sup>25</sup> In our study, the number of patients with only one tooth affected was higher (52.9%).

Different fracture types may occur in luxation traumas either on the affected/adjacent teeth or teeth on the opposite arch. Early treatment of crown fractures accompanying luxation traumas are suggested to successfully treat luxation injuries with crown fractures involving multiple teeth. Researchers emphasized that the defense mechanisms of the pulp start to lose effectiveness in such trauma cases.<sup>31</sup> In our study, the frequency of crown fractures accompanying luxation trauma increased with age. While the researchers most frequently reported concussion and subluxation traumas in luxation injuries accompanied by a crown fracture,<sup>18,31</sup> crown fractures in the permanent teeth were most frequently observed in cases of lateral luxation injuries following subluxation trauma. The low frequencies of concussion and crown fractures in our study may be caused by late consultation to the clinic after trauma.

The time of consultation to the clinic after trauma and trauma types may be related. Patients with only soft tissue injuries and periodontal injuries visited the clinic for treatment earlier than patients with only a crown fracture. Patients with crown fractures not involving the pulp generally visit the clinic at a later time. Previous studies supported this result.<sup>15,23</sup> The fact that visible symptoms are less frequent in patients with less traumatic teeth injuries and that the parents do not realize them may be related to their lateness in visiting the clinics for treatment. On the contrary, pain, bleeding, and functional disorders that accompany soft tissue injuries, as well as age, are reported to be related to early clinic consultation time.<sup>21,23</sup> While it was reported that about half of the patients with luxation trauma in primary teeth visited the clinic within the first 24 hours after the trauma,<sup>17,28</sup> cases treated in the clinic during this period accounted for 22.4% and 24.8% of primary and permanent teeth trauma cases, respectively.

Patients who were treated in the clinic within a few hours or within the first 24 h were those with severe injury such as luxation type intrusion and avulsion injuries.<sup>9,16,25,28</sup> In this study, when intrusion cases were treated in the clinic within the first 24 hours, these cases account for 14.3% and 32.5% of injuries involving the primary and permanent teeth, respectively. Results of the evaluation of avulsion cases revealed that 17.3% of permanent teeth avulsion cases were treated in the clinic on the same day. This finding was similar to that of a study carried out in a dental trauma service in Brazil covering 12 years, reporting a rate of 88.2%.<sup>25</sup> The low ratio in our study were related to the initial years in which the knowledge of patients on post-trauma emergency intervention was quite low. Increased awareness of the patients over time, teachers/students in schools knowing about traumas, arrangements in health insurance system, faculty of dentistry in the region with pedodontists, transfer of current trauma-related knowledge to the dentists in the region, and support provided to the dentists play an important role in reducing this rate. In addition, such a low rate is most frequently related to lower social status and delays related to waiting times for prosthetic rehabilitation.

The limitations of this study included the low number of cases due to the infrequent radiography in the first years of the study over time, missing data, and rejection of families to the use of data in the study.

## CONCLUSION

This study revealed that almost half of the traumatized patients have a history of luxation trauma. Etiologic factors and locations of luxation traumas observed in children and young individuals are in agreement with the findings in the relevant literature. Luxation traumas were observed more frequently in boys, and the number of trauma cases decreased with increasing age. Studies providing knowledge to patients/families and trainers are necessary to decrease the time interval between luxation trauma and clinic visit.

## CONFLICT OF INTEREST

All author declared that there are no conflicts of interest.

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