Evaluation of Dentoalveolar Trauma in Children and Adolescents: a Modified Classification System and Surgical Treatment Strategies for Its Management

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Objective: To retrospectively analyze dentoalveolar trauma in pediatric patients, propose a modified classification, and delineate an approach for its urgent care from the surgeon's perspective.

Patients and Methods: Clinical records of patients, attended at the 'A. and P. Kyriakou' Children's Hospital Department of Oral and Maxillofacial Surgery from 2000 to 2015, were retrieved and data were analyzed.

Results: A total of 365 cases of dentoalveolar trauma, affecting 363 children and adolescents (221 males and 142 females), with an age range from 1 to 15 years, were treated in the authors' department. The most common injury mechanism was falls. The trauma was graded as class II in most patients (41.65%). The anterior maxilla was injured in the majority of the patients (78.35%). In 230 patients (63%) the trauma involved the primary dentition. Two hundred eighty-nine of the patients were treated with local anesthesia on an emergency basis, while in the rest 76 patients general anesthesia was considered mandatory.

Conclusions: Accurate diagnosis, timely treatment, and follow-up are critical for the management of dentoalveolar trauma in pediatric patients. A modified more detailed and severity-specific classification and guidelines for its surgical management may assist practitioners in decision making and effective treatment planning.

Key Words: Children and adolescents, classification, dentoalveolar trauma, surgical treatment

The term ''dentoalveolar trauma'' is used to describe a wide spectrum of injuries that are most common in children and adolescents. These include lesions involving: teeth and periodontium, maxillary or mandibular alveolar socket walls and/or process, extending occasionally to the body of the associated jaw, and adjacent supporting soft tissues.[1,2]

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The etiology and incidence of dentoalveolar trauma in children vary widely, depending on social, cultural, and environmental factors.[3,4] Most frequently, dentoalveolar injuries are associated with accidents or acts of violence,[1,4,5] although the etiology differs considerably among various age groups.[3,6] Among accidents, falls to the ground during daily activity/games are most prevalent, followed by sports injuries and traffic accidents.[3,6] Depending on their etiology, dentoalveolar injuries are occasionally associated with facial fractures.[2,7–10]

The most comprehensive classification of dentoalveolar trauma is Andreasen modification of the WHO classification.[2] According to that bone injuries are classified to: comminution of the alveolar socket, fractures of the labial or lingual/palatal socket wall, fractures of the alveolar region, with or without involvement of the socket, and fractures of the maxillary or mandibular bone, with or without involvement of the alveolar region or socket.[5]

Literature focuses mainly on the epidemiology and treatment of isolated dental injuries and those combined with facial fractures.[7,10] Occurrence of dentoalveolar fractures is occasionally reported, while their treatment strategies are less frequently discussed in the pertinent literature. The need for a successful bone reduction, to support injured teeth and provide better prognosis and uneventful healing, has not been stressed in large series of pediatric patients.

The objective of this study was to retrospectively analyze and evaluate the distribution, severity, and treatment of dentoalveolar trauma patients, registered over a 16-year-long period and to propose a modified, more detailed, and severity-specific approach for their classification and some guidelines for their surgical treatment.

PATIENTS AND METHODS

The authors of this paper have read the Helsinki Declaration and have followed the guidelines in this investigation.

Data of children who were treated for dentoalveolar trauma at the University Department of Oral and Maxillofacial Surgery of the 'A. & P. Kyriakou' Children's Hospital of Athens during a period of 16 years (2000–2015) were collected and evaluated. Information retrieved included demographic data, mechanism of injury, type and location of the dentoalveolar trauma, presence and type of concomitant injuries, and applied treatment approach.

The data of patients with dental trauma not involving the socket walls or the surrounding alveolar bone (ie, fractures of dental hard tissues or subluxated teeth) were not included in this study, since such patients did not require "surgical" treatment and were directly referred to paediatric dentists.

The type of dentoalveolar trauma was determined according to a modified version of the Andreasen classification system and each patient was assigned to one of the following categories: Class I, that is contusion of the alveolar socket wall(s) that results in expanded or modified shape of the socket, Class II, that is fractures of the alveolar socket walls involving either the buccal/labial or lingual/palatal plate of the alveolar process, Class III, that is comminution of the socket, Class IV, that is segmental fractures involving a greater area of the alveolar process, usually including multiple teeth, and Class V, that is complex fractures at the base of the maxillary or mandibular alveolar process, extending to the body of the maxilla/mandible.

Following clinical examination, periapical radiographs, orthopantomograms, or plain skull x-rays were taken, to confirm the clinical diagnosis and/or detect any concomitant lesions, affecting the patient's hard tissues. Computed tomography scans were performed only in severe trauma patients of classes IV and V, as well as in patients involved in traffic accidents.

Treatment strategies included alveolar bone fracture reduction (closed and/or open), permanent teeth repositioning and/or deciduous teeth removal, suturing of the soft tissues, and splinting of the

TABLE 1. Distribution Into Classes (I–V) of the Dentoalveolar Trauma Patients, Treated in Our Department From 2000 to 2015, According to the Modified Classification System Proposed in the Present Study

Trauma Class	Total	%
Class I	120	32.87
Class II	152	41.65
Class III	66	18.08
Class IV	22	6.02
Class V	5	1.38
Total	365	100.0

TABLE 2. Distribution of the Dentoalveolar Trauma Patients, Treated in Our Department From 2000 to 2015, Into Classes (I–V), Depending on the Type of Anesthesia Implemented for Their Treatment

Trauma Class	Local Anesthesia	%	General Anesthesia	%
Class I	120	32.87	0	0
Class II	135	37	17	4.65
Class III	28	7.67	38	10.41
Class IV	6	1.64	16	4.38
Class V	0	0	5	1.38
Total	289	79.18	76	20.82

affected permanent teeth. Although patients of mild dentoalveolar trauma (classes I and II) treated with local anesthesia have been recorded and included in the present study, attention has been focused on the severe trauma requiring surgical treatment, in several patients under general anesthesia.

Concomitant teeth injuries of our patients were not treated on an emergency basis in our department. However, in the majority of the patients, paediatric or general dentistry assistance was obtained on site and continued after the patients' release from hospital, according to the established protocols. Therefore, follow-up from the surgeon's standpoint lasted only until the trauma healed. Only for patients with multiple injuries and those who required osteosynthesis, was the follow-up period within our department extended accordingly. In addition, for the needs of the present study several patients, mostly patients requiring surgical approach, that is fractures of classes III, IV, or V, were selected for long-term follow-up, to have their present condition registered.

RESULTS

Demographic Data

A total of 365 patients of dentoalveolar trauma in children and adolescents were included in the study. Patient ages at the time of injury ranged from 1 to 15 years, with a mean of 6.9 ± 2.4 years. Male-to-female ratio was 1.41:1 or 58.5% to 41.5%. The most common mechanism of injury among our patients was falls (40.75%), followed by play- or sports-related accidents (36.25%) and road traffic accidents (23%).

Type of Injury, Dentition, and Site Involved

Type of Injury

Lateral luxation, followed with declining frequency by avulsion and intrusion, was the most common clinical finding among our patients; soft tissue lacerations were also encountered with almost the same frequency.

The most frequent type of dentoalveolar trauma among our patients was of class II (41.65%), followed by class I (32.87%) and class III (18.08%); a few patients (6.02%) were graded as class IV and only 5 patients (1.38%) had suffered complex fractures of class V. Table 1 summarizes the distribution of the dentoalveolar trauma patients, treated in our department from 2000 to 2015, into classes I to V.

Dentition Involved

In 230 of the 365 patients (63%) the trauma affected the primary dentition whereas in the rest 135 patients (37%) the trauma involved permanent teeth.

Site Involved

The anterior maxilla was most often injured (in 286 of the 365 patients or 78.35%), while the anterior mandible was injured in 62 of the 365 patients (16.99%). Incisors (both deciduous and permanent) represented the most commonly affected teeth. In 15 of the 365 patients (4.1%) dentoalveolar trauma involved the anterior region of both the maxilla and mandible. Finally, the posterior mandible was injured in 2 patients (0.55%): 1 patient with a class II fracture of the left mandibular alveolar process, involving both deciduous molars and 1 patient with a class IV fracture, extending between the 75 and 85 teeth, thus involving both the anterior and a considerable part of the posterior mandible bilaterally.

Treatment Options and Procedures

Classification of the Dentoalveolar Trauma Patients, Based on the Type of Anesthesia Implemented for Their Treatment

Two hundred eighty-nine of the 365 patients (79.18%) were treated with local anesthesia, whereas in the rest 76 patients (20.82%) general anesthesia was implemented.

Among the 289 patients, treated with local anesthesia with a mean age of 5.9 ± 2.3 years at the time of injury, the male-to-female ratio was 1.7:1 (182 boys and 107 girls). In 205 of these patients the trauma involved deciduous and in 84 patients permanent teeth. According to the previously described classification of dentoalveolar trauma among the lesions, treated with local anesthesia, 135 were of class II, 120 of class I, 28 of class III, and 6 of class IV (Table 2).

Among the 74 patients (76 patients), operated under general anesthesia with a mean age of 8 ± 1.8 years, the male-to-female ratio was 1.11:1 (39 boys and 35 girls). In 25 of these patients the trauma affected only the primary dentition, whereas in 51 patients permanent teeth were involved. According to our classification, the distribution of alveolar trauma among these patients was as follows: the most common type of injury was class III (38 patients), followed by class II (17 patients), class IV (16 patients), and class V (5 patients), since 2 of the patients exhibited at the same time a class III fracture of the maxilla and a class IV fracture of the mandible; no dentoalveolar trauma patients of class I were treated under general anesthesia (Table 2).

Injured Teeth Handling

In general, severely malpositioned deciduous teeth were removed and the area was cleaned and sutured; only in sparse patients of mild luxation the deciduous teeth were maintained and the child was referred to pediatric dentists for follow-up. Permanent teeth were repositioned and alveolar wall(s) were digitally compressed. Within the emergency department temporary splinting was achieved by means of acid-etch wiring in most of the patients. Coexisting soft tissue lacerations were sutured.

Correlation of Trauma Class to Anesthesia and Treatment Required

All patients of class I dentoalveolar trauma (120 of the overall 365 patients or 32.87%) were treated with local anesthesia; those of

class II (152 of the 365 patients or 41.65%) were treated in their majority (135 patients or 37%) with local anesthesia and only in 17 patients (4.65%) general anesthesia was opted for. Displaced permanent teeth were repositioned digitally along with the fractured socket walls and bone plates were compressed; avulsed teeth were reimplanted, when warranted, with or without prior root canal treatment. Splinting and soft tissue management were applied, as described for lesions of class I.

In patients of class III dentoalveolar trauma (66 of the 365 or 18.08%), open reduction under general anesthesia was performed in 38 patients (10.41%) but 28 patients (7.67%) were treated with local anesthesia in the emergency department. In either case fragments attached to periosteum were preserved while loose ones, as well as involved deciduous teeth, were removed; repositioning of the teeth, soft tissue management, and splinting were applied accordingly.

Patients with dentoalveolar trauma of class IV (22 of the 365 lesions or 6.02%) were treated either within the emergency department (6 patients) or under general anesthesia (16 patients). In 16 patients open reduction to reposition the alveolar fragment was required and splinting procedures followed accordingly. Internal fixation with microplates was considered mandatory in 6 patients.

Finally, 5 of our patients had suffered complex fractures, located at the base of the maxillary alveolar process and extending to the maxilla (and the nasal bones in 1 patient). Treatment included repositioning under general anesthesia and internal fixation with titanium microplates.

Wide spectrum antibiotics were administered to all patients perioperatively. Treatment strategies were determined and applied in conjunction with paediatric dentists, when required, according to the guidelines here presented, depending on the type (class) of each lesion.

Follow-Up and Complications

All patients were referred to pediatric or general dentists for further treatment of teeth-related concomitant lesions (ie, crown fractures with or without pulp exposure). In several patients referral to orthodontists was also required for further treatment of trauma-related occlusion discrepancies. Patients suffering from more severe trauma of classes IV and V who had been submitted to osteosynthesis were followed up in our department until their trauma was healed, while microplates were removed at a later stage.

During follow-up period no infection occurred in any of our patients. Alveolar bone fractures and injured oral soft tissues healed uneventfully in all our patients and only minor scars could be observed in patients who originally exhibited extended skin lacerations.

DISCUSSION

The term "dentoalveolar trauma" comprises combined injuries, affecting the teeth, supporting soft tissues (periodontium, gingivae, and alveolar mucosa), and surrounding bone (alveolar portion of the maxilla or mandible).[1,2,5]

Precise clinical examination is required to fully reveal the nature and extent of injury.[2,3,11] Displaced fragments of teeth and/or surrounding bone and disturbance of the occlusion are the most typical findings, whereas teeth mobility or hematoma of the adjacent gingivae or mucosa may be indications of alveolar fractures.[1,11] Similar findings were recorded in our patients.

Description of the accident mechanism may provide useful information for the expected type of trauma and an indication for the clinical and/or radiographic examination required for diagnosis.[11] The most common mechanisms of injury among our patients were falls, followed by play- or sports-related accidents and road traffic accidents; this lies in accordance with findings of other studies, including pediatric patients.[3,5,7,12]

Radiographic examination often requires multiple radiographs with varying vertical angulation to highlight the fracture line. Intraoral radiographs of the socket walls only occasionally reveal the fracture, contrary to laterally exposed extraoral ones or combinations.[1,11] Orthopantomograms, although impossible in very young children, help in determining the course of fracture lines extending to the maxilla or mandibular body, particularly when combined with intraoral radiographs to show the relation between involved teeth and fracture line. In our series of patients radiographic examination proved subsidiary as a rule but was useful in selected patients of severe dentoalveolar trauma (mostly of classes IV and V), to detect concomitant lesions (for instance fractures of the condyle in 2 patients).

The higher incidence of trauma among male pediatric patients and the mean age at the time of injury (6.9 years), registered in the present study, are comparable to those reported in the international literature.[3,6,8,12,13] Although data regarding the type and site of dentoalveolar injuries vary considerably, several authors point out that luxations of maxillary teeth, either alone or combined with injuries of the supporting bone and soft tissue lacerations, are particularly prevalent among pediatric patients.[3,7,14] Although only a few studies focus on patients of dentoalveolar trauma requiring surgical treatment,[15,16] in the present study surgical intervention under general anesthesia was considered necessary in 20.82% of the patients.

Regarding the treatment of dentoalveolar trauma, the parameters that should be taken into consideration include the patient's age (related to the type of dentition involved and the patient's cooperation level), the complexity of the injury, and the time elapsed.[14–16] Treatment of alveolar fractures requires repositioning of teeth and splinting for 3 to 4 weeks. The time interval between injury and management substantially determines prognosis and indicated treatment strategy, since periodontal and pulpal healing require early repositioning.[13]

In our patients, all efforts were aimed at minimizing the time interval between clinical examination and management, although the time elapsed from injury varied significantly from 1 to 12 hours. All patients were treated on an emergency basis, either within the emergency department or under general anesthesia in the operating room, depending on the complexity/severity of the trauma and the patient's age and level of cooperation. However, even in patients of delayed treatment, in which teeth vitality was considerably jeopardized, attempts were made to reposition and preserve the affected anterior teeth for both aesthetic and psychological reasons. In these cases, patients and their parents were informed about the potential complications and limitations of such a procedure, as well as of the necessity of further treatment and follow-up by pediatric or general dentists until adulthood.

Regarding stabilization, the current literature supports short-term, nonrigid splinting of alveolar fractures, using either an acid-etch/resin splint or arch bars,[1,11,13] although it has been shown that neither the specific type of splint nor the duration of splinting is significantly related to treatment outcomes.[13] Nevertheless, arch bars may significantly influence the time and quality of gingival healing or even jeopardize the stability of reimplanted teeth; therefore, in many patients of severe trauma with subsequent alveolar bone loss a longer stabilization period by means of orthodontic appliances may represent the treatment of choice. A fixation period of 4 weeks is usually recommended, although the rapid healing in children may reduce this period to 3 weeks. In our study most patients received acid-etch/composite splinting but arch bars were also used, especially during the first 3 years of the study.

TABLE 3. The Proposed Modified Classification of Dentoalveolar Trauma (Classes I–V) and Respective Indicated Treatment Strategies

	Class	Clinical Associations	Treatment
I	Contusion and expansion/modification of socket walls	Associated with lateral/intrusive luxation and occasionally having apexes penetrating an alveolar wall	Repositioning of permanent teeth + splinting
II	Fracture of the socket walls extending to the plate of alveolar process	Associated with lateral luxation or avulsion	Repositioning of permanent teeth, socket walls and alveolar process with digital maneuvers + splinting
III	Socket comminution	Associated with intrusive or lateral luxation producing a crushing type of injury	Digital maneuvers or open reduction + splinting
IV	Segmental fracture including multiple teeth	Associated with extrusive or lateral luxations and root fractures	Open reduction ± internal fixation + splinting
V	Complex alveolar fracture located at the maxillary or mandibular alveolar process	Extended to maxillary/mandibular body and associated with severe luxations or avulsions	Open reduction + teeth repositioning + internal fixation + splinting

Based on the information, retrieved from our patients' charts, a more detailed than the previously proposed classification of dentoalveolar fractures,[2] associated with the degree of bone involvement and the required treatment, has been developed (Table 3). The touchstone of the present classification is that it actually grades trauma severity, starting from light injuries (Class I) that consist in contusion of the socket wall(s) without fracture and do not require surgical treatment and ending with complex fractures (Class V) that extend to the body of the maxilla/mandible and usually require internal fixation with microplates. We believe that this more detailed and severity-specific approach might assist clinicians who deal with dentoalveolar trauma not only in accurate diagnosis but also in decision making and effective treatment planning.

After having taken into consideration the above-described general principles, we propose the following treatment strategies for each type of lesion.

Class I: The severity of the injury and the type of involved dentition mostly determine treatment. Severely malpositioned deciduous teeth are usually removed and the area is cleaned and sutured; mildly luxated deciduous teeth with minor mobility, not interfering with occlusion, may be maintained but the child should be referred to pediatric or general dentists for follow-up. Permanent teeth are repositioned within their sockets and the alveolar wall/walls is/are digitally compressed to its/their original place. Acid-etch/resin splints or arch bars are placed for at least 2 weeks after injury. Prior to splint removal a radiograph should be taken to ascertain healing.

Class II: Treatment depends on the severity of the trauma, the type of involved dentition, and the time elapsed from injury. Displaced or avulsed permanent teeth are repositioned, whereas malpositioned deciduous teeth should be removed and reimplantation of avulsed ones should not be attempted. A labial flap may be helpful to repositioning.[11] Disengaging the apices from the vestibular bone plate can be achieved by simultaneous digital pressure in an incisal direction over the apex and in a buccal/labial direction lingually of the crown. Although this maneuver also allows repositioning of the socket walls, the labial and palatal/lingual bone plates should additionally be compressed, to ensure repositioning and facilitate periodontal healing. The guidelines for soft tissue management and splinting, described in lesions of class I, also apply to such lesions.

Class III: Treatment depends on the severity and extent (number of sockets involved) of the trauma and the concomitant lesions of both soft and hard tissues. Open reduction usually helps to maintain fragments attached to periosteum or remove loose fragments and debride crashed alveolar bone.[1,5] Even when the entire vestibular plate is removed, remaining structural support suffices to ensure teeth stability.[1] Repositioning of the tooth (teeth) and viable alveolar socket walls, soft tissue management, and splinting are applied accordingly, as described above. A longer splinting period of 4 to 6 weeks may be necessary due to initial resorption of the injured bone that retards periodontal healing.

Class IV: Treatment usually requires open reduction and immobilization, depending on the displacement extent of the fractured segment, its liability to digital repositioning and stability after reduction, as well as the availability of teeth for adequate splinting. Involved apices may be locked in position by the vestibular bone plate. Reduction follows the principles presented for lesions of classes II and III. Associated soft tissue lacerations should be sutured afterward to allow access for intraoral manipulation. Internal rigid fixation is generally not required but splinting for 3 to 4 weeks is usually advocated. However, lack of sufficient teeth for splinting procedures may warrant microplate insertion, to achieve adequate fixation of the fractured alveolar segment. Teeth within loose alveolar fragments may require further treatment due to marginal or periapical inflammation.

Class V: Treatment of such fractures in children follows the above principles, that is exact repositioning and as a rule internal fixation with microplates. These aim primarily to preserve developing teeth, the presence of which in the fracture line may increase the infection risk, especially if they are multirooted and/or semi-erupted.[17]

Despite the children's great osteogenic potential, that substantially reduces the need for surgical treatment among pediatric patients,[16,17] it is the authors' belief that open reduction and internal rigid fixation not only represent the treatment of choice for trauma of class V but may also be warranted for selected patients of classes III and IV. In any case treatment should be individualized, depending on the dislocation extent of the fractured segment, its liability to repositioning and stability after reduction, concomitant lesions, and number of teeth available for splinting procedures.

Complications of dentoalveolar trauma may occur immediately, early, or later. These are related to: bone and soft tissue trauma that favors inflammation and abscess formation in the fracture area, resulting from inappropriate disinfection of the site or difficulty in healing and/or loss of marginal bone support, due to unsuccessful reduction of bone fracture, and dental injury repercussions, such as pulp necrosis and periapical inflammation, pulp canal obliteration, root resorption, and developmental dental anomalies, associated with trauma of the tooth germ.[1,5,13] Careful long-term follow-up and subsequent interventions by specialists are mandatory to timely diagnose and successfully treat these omplications.[1,13] In the present study, no complications such as abscess formation or healing disturbances were noticed, while no later repercussions, associated with the dental injury, were recorded.

CONCLUSIONS

The management of dentoalveolar trauma in pediatric patients represents a complex procedure that requires a comprehensive and accurate diagnosis, as well as treatment planning, based on a multidisciplinary approach.

In this series of patients all patients of dentoalveolar trauma were treated on an emergency basis by staff members of the Department of Oral and Maxillofacial Surgery, assisted on site by pediatric dentists, when required. Based on our experience, we delineated a modified, more detailed, and severity-specific classification of dentoalveolar trauma actually involving the alveolar bone and proposed some guidelines for its management that in selected patients may require surgical intervention under general anesthesia.

These guidelines may assist dental practitioners, confronted with the primary evaluation of dentoalveolar trauma, in decision making and effective treatment planning. Following initial treatment on an emergency basis, children and adolescents should be referred to specialized pediatric dentists for follow-up and/or additional treatment, to assure the most favorable outcome.

REFERENCES

1. Andreasen JO. Injuries to the supporting bone. In: Andreasen JO, Andreasen FM, Andersson L, eds. *Textbook and Color Atlas of Traumatic Injuries to the Teeth*. 4th ed. Oxford, UK: Blackwell; 2007:489–515.
2. Macleod SP, Rudd TC. Update on the management of dentoalveolar trauma. *Curr Opin Otolaryngol Head Neck Surg* 2012;20:318–324
3. Wright G, Bell A, McGlashan G, et al. Dentoalveolar trauma in Glasgow: an audit mechanism and injury. *Dent Traumatol* 2007;23: 226–231
4. Eggensperger Wymann NM, Hölzle A, Zachariou Z, et al. Pediatric craniofacial trauma. *J Oral Maxillofac Surg* 2008;66:58–64
5. Casey RP, Bensadigh BM, Lake MT, et al. Dentoalveolar trauma in the pediatric population. *J Craniofac Surg* 2010;21:1305–1309
6. Gassner R, Tuli T, Hächl O, et al. Craniomaxillofacial trauma in children: a review of 3,385 cases with 6,060 injuries in 10 years. *J Oral Maxillofac Surg* 2004;62:399–407
7. Lieger O, Zix J, Kruse A, et al. Dental injuries in association with facial fractures. *J Oral Maxillofac Surg* 2009;67:1680–1684
8. Lin S, Levin L, Goldman S, et al. Dento-alveolar and maxillofacial injuries: a 5-year multi-center study. Part 1: general vs facial and dental trauma. *Dent Traumatol* 2008;24:53–55
9. Lin S, Levin L, Goldman S, et al. Dento-alveolar and maxillofacial injuries: a 5-year multi-center study. Part 2: severity and location. *Dent Traumatol* 2008;24:56–58
10. Marchiori EC, Santos SE, Asprino L, et al. Occurrence of dental avulsion and associated injuries in patients with facial trauma over a 9-year period. *Oral Maxillofac Surg* 2013;17:119–126
11. Leathers RD, Gowans RE. Management of alveolar and dental fractures. In: Miloro M, Ghali GE, Peterson LJ, eds. *Peterson's Principles of Oral and Maxillofacial Surgery of Volume 1*. et al, eds. *Peterson's Principles of Oral and Maxillofacial Surgery of Volume 1*. Shelton, CT: People's Medical Publishing House; 2004:383–400
12. Azami-Aghdash S, Ebadifard Azar F, Pournaghi Azar F, et al. Prevalence, etiology, and types of dental trauma in children and adolescents: systematic review and meta-analysis. *Med J Islam Repub Iran* 2015;29:234
13. DiAngelis AJ, Andreasen JO, Ebeleseder KA, et al. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations of permanent teeth. *Dent Traumatol* 2012;28:2–12
14. Turkistani J, Hanno A. Recent trends in the management of dentoalveolar traumatic injuries to primary and young permanent teeth. *Dental Traumatol* 2011;27:46–54
15. Muñante-Cárdenas JL, Olate S, Asprino L, et al. Pattern and treatment of facial trauma in pediatric and adolescent patients. *J Craniofac Surg* 2011;22:1251–1255
16. Andrade NN, Choradia S, Sriram SG. An institutional experience in the management of pediatric mandibular fractures: a study of 74 cases. *J Craniomaxillofac Surg* 2015;43:995–999
17. Ellis E 3rd. Outcomes of patients with teeth in the line of mandibular angle fractures treated with stable internal fixation. *J Oral Maxillofac Surg* 2002;60:863–866