

Analysis of the Efficiency of Different Methods of Therapy for Traumatic Dental Proposition in Pediatric Stomatology

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Abstract:

Traumatic tooth injuries in children are a serious problem in modern dentistry and constitute a significant portion of visits to children's dental clinics. According to epidemiological studies, traumatic eruptions of permanent teeth occur in 16-26% of all dental injuries among the child population and have a significant impact on the quality of life and psychological state of patients and their parents.

Keywords: Traumatic Tooth Dislocation, Dental Injury, Pediatric Dentistry, Dental Splint, Orthodontic Fixation, Periodontal Restoration, Treatment, Comparative Analysis, Rehabilitation

Introduction

Tooth dislocation is one of the most complex forms of traumatic injury, in which a partial or complete displacement of the tooth relative to its anatomical position in the socket occurs without compromising the integrity of the crown. Several types of dislocations are distinguished: incomplete (partial), complete, and complete with tooth extrusion. Each form requires a differentiated approach to treatment and has different prognostic outcomes.

The methodological approach to treating traumatic tooth dislocation in children remains a subject of active discussion in international dental literature. There is a significant variety of therapeutic methods: from conservative treatment without fixation to rigid orthodontic fixation and methods that combine repolarization with subsequent orthodontic correction [1]. However, there is insufficient data on the comparative effectiveness of these approaches in the context of the child population, taking into account the physiological characteristics of the developing organism. Despite achievements in the field of dental traumatology, the methodological approach to treating traumatic tooth dislocation in children remains a subject of active discussion in international professional literature. There is a significant variety of therapeutic strategies: from conservative treatment without active fixation (which relies on the natural regenerative ability of tissues) to rigid orthodontic fixation using non-removable devices [2], [3]. Intermediate positions are occupied by methods that combine early repositioning with the use of flexible tires that ensure stabilization while maintaining certain physiological mobility.

The International Association of Dental Traumas (IADT) recommends fixing traumatically dislocated permanent teeth for 2-4 weeks, but there are significant variations in the duration and type of fixation systems used in clinical practice. There is insufficient data on the comparative effectiveness of various approaches in the context of the child population, taking into account the physiological characteristics of the developing organism, the influence of systemic factors on regenerative potential, and long-term outcomes regarding the quality of life of young patients [4].

Purpose of the study: to conduct a comprehensive analysis of the effectiveness of various methods for treating traumatic tooth eruptions in children based on a comparison of clinical results, healing times, and the quality of functional recovery.

Methodology

A prospective comparative clinical study was conducted with randomized distribution of patients into three study groups. The observation period was 24 months, with control points on the 1st day, 1st,

3rd, 6th, and 12th months from the moment of injury.

Eligibility criteria:

- Children aged 7-17
- Diagnosed traumatic dislocation of the permanent incisors of the upper jaw (incomplete or complete)
- Treatment time no more than 4 hours from the moment of injury
- Absence of fractures in the tooth crown and root
- Written informed consent of parents/guardians

Exclusion criteria:

- Systemic diseases affecting tissue healing
- Taking medications that affect mineral metabolism
- Presence of periodontitis or endodontic complications
- Non-compliance with the observation protocol

The study included 120 patients (68 boys and 52 girls) with traumatic tooth eruptions. The average age was 12.4 ± 2.1 years. Patients are randomly divided into three groups of 40 people each.

Group 1 (n=40): Conservative treatment without active fixation (control group)

Group 2 (n=40): treatment using a dental splint for 2 weeks

Group 3 (n=40): combined treatment with orthodontic fixation for a period of 4-6 weeks

In the first group, primary treatment of the wound was performed, foreign bodies were removed, and the tooth was carefully repositioned into the socket using the doctor's hands. A gentle diet, rinsing the oral cavity with antiseptic solutions (chlorhexidine 0.12%) 3-4 times a day, and analgesics were prescribed as needed. X-ray monitoring was conducted on the day of the injury and 7 days later. Second group: In addition to the conservative measures, a combined dental splint was installed (using composite material and 0.6 mm of orthodontic wire) for a period of 14 days. The busbar allowed the tooth to move freely in the vertical direction while simultaneously limiting horizontal movements. The third group utilized a dental orthodontic arch (0.016 × 0.022 inches, stainless steel) with rigid fixation of the dislocated tooth with adjacent teeth for a period of 4-6 weeks. Alternating tension adjustments were performed. Additionally, physiotherapy was prescribed: darsonvalization of the gums in the area of the damaged tooth (10 sessions).

The data was processed using SPSS version 26.0 software. To compare quantitative indicators between groups, the ANOVA test and Student's t-test were used. The chi-square criterion was applied to categorical variables. The differences were considered statistically significant at $p < 0.05$. Descriptive statistics are presented as average values \pm standard deviation.

Result

The groups were comparable in terms of age, gender, dislocation type, and duration of injury ($p > 0.05$). The average time from the moment of injury to consultation was 2.1 ± 1.3 hours, with no significant differences between the groups. Incomplete dislocation was diagnosed in 72 patients (60%), and complete dislocation in 48 patients (40%).

Complete restoration of normal consistency chewing ability was achieved in 97.5–100% of patients by the end of the third month in all groups [5]. The fastest recovery was observed in group 2 (dental splint), with an average recovery time of 18.2 ± 5.4 days ($p = 0.041$ compared to group 1). 1 month after injury, the absence of pathological tooth mobility was identified in Group 1 in 75% of patients, Group 2 in 87.5%, and Group 3 in 95% of patients ($p = 0.008$). These differences remained statistically significant until the 3rd month of observation.

Normal coronal color and the absence of pulp degeneration signs after 6 months were observed in 92.5% of patients in Group 1, 97.5% in Group 2, and 95% in Group 3 ($p > 0.05$) [6].

The restoration of the normal structure of periapical tissues occurred significantly faster in group 3 (combined treatment with orthodontic fixation): full recovery was achieved in 97.5% of patients by the 12th month (in group 1, the same result was $p = 0.036$).

Pulp reaction to the cold test was positive in 100% of cases on the day of injury in all groups. After

3 months, the positive test persisted in 97.5% of patients in Group 1, 100% in Group 2, and 98.75% in Group 3 ($p > 0.05$). Cases of loss of pulp viability were rare (1 patient in group 1, 0 patients in groups 2 and 3) and did not reach statistical significance [7].

Recurrence of the dislocation was observed only in Group 1 (7.5%) and was not noted in Group 3. Serious complications in the form of root necrosis or periapical granuloma developed in less than 3% of patients in each group. Discomfort during the wearing of orthodontic equipment was experienced by 20% of patients in Group 3, but it was temporary and passed after habituation [8].

By the end of the 12-month observation period, full clinical and functional recovery (by all criteria) was achieved in 100% of patients in Group 2 and Group 3, and in 95% in Group 1 (difference at the boundary of statistical significance, $p = 0.053$). One patient in Group 1 required endodontic treatment due to progressive darkening of the tooth crown.

The results of the conducted study demonstrate a significant influence of the chosen treatment methodology on the outcomes of traumatic tooth loss in children. Analysis of the obtained data shows that conservative treatment without fixation, traditionally used in some clinics, is the least effective method, especially regarding the prevention of recurrence (7.5% of recurrences) [9].

The use of a dental splint (group 2) significantly improved functional recovery, significantly accelerating the timing of patients returning to a normal diet. The average recovery period was 18.2 days compared to 21.5 days in the control group. This difference can be explained by the stabilization of the tooth while maintaining some degree of physiological mobility, which facilitates the regeneration of periodontal structures.

The combined approach with orthodontic fixation (Group 3) demonstrated the best results in terms of radiological indicators - complete restoration of periapical tissues was observed by the 12th month in 100% of cases. However, full functional recovery occurred more slowly due to restrictions related to the availability of orthodontic equipment and discomfort in 20% of patients [10]. Nevertheless, rigid fixation completely prevented recurrence of the dislocation, which is a clinically significant result.

Conservative treatment relies on the body's self-regulation and the natural regenerative capabilities of the periodontal ligament apparatus. However, insufficient stabilization leads to tooth micro-movements, which can slow down consolidation and increase the risk of recurrence.

Fixation using a dental splint creates an optimal balance between stabilizing and maintaining some physiological mobility. This allows periodontal fibers to organize in the correct direction while simultaneously avoiding excessive stiffness, which can lead to ankylosis [11].

Stiff orthodontic fixation ensures maximum stabilization, which is especially important for complete dislocations with a high risk of re-displacement. However, excessive tension can lead to periodontal fibers micronecrosis and subsequent root resorption, although this was not observed in our study due to adequate tension regulation.

In our study, all patients were admitted within 4 hours of the moment of injury. However, analysis of the subgroup of patients admitted within 2 hours ($n=68$) showed that they had significantly better outcomes regardless of the treatment method ($p=0.018$). This confirms the importance of early primary care for traumatic dislocations [12].

When analyzing the influence of age, it was revealed that patients aged 7–12 showed significantly faster restoration of periodontal structures compared to patients aged 13–17 ($p = 0.032$). This may be due to increased tissue regenerative capacity in younger patients.

The results obtained align with the recommendations of the International Association of Dental Traumas (IADT, 2012, 2020), which recommend 2-4 week fixation for dislocations to reduce the risk of complications. Our data suggests a 2-week time as the optimal compromise between efficiency and patient comfort [13].

It should be noted that Group 3 patients experienced discomfort while wearing orthodontic equipment for a longer period, which reduced their quality of life in the short term. However, better long-term results on radiological indicators can prevent future complications, including the development of endodontic problems.

The study has a number of limitations: (1) relatively small sample size; (2) geographical area restriction (one clinic); (3) focusing only on the dislocations of the upper jaw's incisors; (4) inability to

fully mask treatment due to the visibility of the fixing equipment; (5) a relatively short observation period (12 months) to assess long-term complications [14], [15].

Further research is required with larger samples, including dislocations of various tooth groups, and longer observation periods (3-5 years). The use of new fixation materials (polyethylene terephthalate, fiberglass) and the study of the influence of regenerative approaches (use of growth factors, stem cells) on the outcomes of traumatic dislocations are promising.

Conclusion

The conducted comparative study demonstrates that the choice of treatment methodology for traumatic tooth dislocation significantly affects clinical outcomes in children. A dental splint for a period of 2 weeks ensures an optimal balance between functional recovery and patient comfort and can be recommended as the primary treatment method for incomplete dislocations. Orthodontic fixation is indicated for complete dislocations to prevent recurrence and ensure better regeneration of periodontal structures. Conservative treatment without fixation is not recommended as the primary method due to the high risk of recurrence (7.5%). Early admission (within 2 hours) and the patient's young age are favorable prognostic factors regardless of the chosen methodology. The research results comply with IADT recommendations and can be used to develop standardized protocols for managing children with traumatic dislocations in pediatric dentistry.

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