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QUANTIFICATION OF TRAUMATIC DENTAL INJURIES IN FORENSIC PRACTICE

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ABSTRACT

Traumatic dental injuries are common in dental pathology and have great importance in forensic practice in assessing the gravity of trauma and traumatic mechanism which further allow the legal framing of the criminal offences that caused them. The dentist has the responsibility to provide an accurate and detailed description of these injuries and should effectively collaborate with the forensic pathologist to elucidate the possible cause of traumatic dental injuries. Material and method: The authors analyze the current indicative scale used in forensic practice for assessing the gravity of traumatic injuries. Results and discussions: In the section dedicated to dental injuries, the scale list the traumatic dental injuries and the number of days of medical care needed for healing for each of them, this being the forensic criterion for assessing the gravity of the traumatic injuries. The authors also analyze the way in which the traumatic dental injuries observed in a corpse allow the establishment of the traumatic mechanism and the contribution of these injuries to death. Conclusions: The correct assessment of the traumatic dental injuries and of these lesions corresponding description taken by the dentist is a key element in the correct quantification of the gravity of the traumatic dental injuries and establishing of relevant conclusions in forensic expertise. In many cases where dental injuries are identified, the collaboration between the forensic pathologist and the dentist is essential for the correct assessment of the injuries and of the traumatic mechanism.

Key words: trauma, dental injuries, dentistry, gravity, mechanism, death, forensic medicine

INTRODUCTION

Traumatic dental injuries are among the most frequent injuries in the forensic practice. Their incidence varies according to the age, gender, origin or socio-economic situation of the victim. The incidence of traumatic dental injuries increases around the age of one year old, when the child begins to walk and reach a maximum peak at school age. The growing incidence of these injuries is also due to the growing popularity of the contact sports in population [1- 5].

Although traumatic dental injuries have a relatively high frequency, their actual number is not precisely known because, sometimes, the traumatized person fails to access the specialized medical care. On the other hand, there are traumatic dental injuries without subjective or objective clinical symptoms that remain undetected.

Dental trauma can occur in various circumstances, being produced most

frequently by mechanical agents, followed by the physical and chemical ones.

Dental injuries may be determined by a direct trauma (a direct hit), of a variable intensity, on dental arch or on mandible (most frequently on the chin), the shock being transmitted to the antagonists teeth. Compression of a rough object on the premolar occlusal surface during mastication can also produce dental injuries. The victim may also fall with the impact of its face on an irregular surface, followed by dental injuries. Rarely, dental lesions may be of iatrogenic etiology, by slipping of extraction instruments (clippers, elevator), dislocation of neighboring teeth through inadequate support or even during the tracheal intubation. Therefore, the dental injuries may be the result of a direct mechanism - when the tooth itself is hit- which determines injuries in the anterior maxillary region (central incisor) or of an indirect mechanism which occurs when the mandible is forced to occlude with the upper arch; this mechanism promotes the occurrence of the coronal fractures in the posterior region of dental arches, coronal-radicular fractures, and fractures in the region of condyles and symphysis of the mandible [6, 7].

Several factors may facilitate the dental trauma, including: dental malposition, dental protrusion, reduction of the resistance of the dental structures by dystrophy (dental hypo-calcification or hyper-calcification), caries, fillings, coronal-radicular reconstructions, chronic marginal periodontitis and triggering seizures.

Dental trauma may damage the hard structure of the teeth, with or without the damage of the pulp cavity or of the periodontal structures. These lesions are often accompanied by lesions of the orofacial soft parts or of the maxillary bones, which adds to the gravity of the trauma, with possibility of the evolution towards the death of the victim.

A particular category of dental trauma is harming the teeth during the endodontic treatment. Fractures of these teeth are generally vertical being favored by the loss of dental hard substance, unsustain enamel prisms, previous enamel fractures or iatrogenic factors such as excessive removal of dentin, excessive widening of root canals during preparation for coronal-radicular reconstructions, excessive pressure during lateral condensation of gutta-percha [8].

All the above-mentioned aspects are of a major importance in forensic practice both for quantification of severity of dental injuries and for establishing the traumatic mechanism in living or deceased victims.

MATERIAL AND METHOD

We analyzed the tools which can be used in the forensic practice to assess the gravity of the traumatic dental injuries. We also analyzed the way in which these injuries need to be described by both the dentist and the forensic pathologist so that the traumatic mechanism can be properly assessed in the forensic expertise.

RESULTS AND DISCUSSIONS

In forensic practice traumatic dental injuries are common and usually associated with lesions of the neighboring soft tissues (lips, vestibular mucosa, tongue, etc.). The role of the forensic physician who detects traumatic injuries on the victim's body is to establish the traumatic mechanism and also to assess their gravity [9, 10].

Estimation of the gravity of the traumatic injuries in forensic practice

In the forensic practice, the severity of the traumatic injuries is evaluated on the basis of the *number of days of medical care for healing*, which is established according to the anatomical and functional impact of the injury on the victim's body as well as according to the treatment that the victim

needs and its clinical evolution. Thus, the number of days of medical care for healing does not represent a simple count of the number of days the victim received treatment but is a way of estimating the severity of a traumatic injury through its impact on the victim's body. The number of days of medical care for healing and the traumatic mechanism are essential aspects for the judicial framing of the offence which caused the injuries identified in victims in one of the articles of the Romanian Criminal Code concerning the hitting and injury, i.e. article 193 and article 194[1]. Obviously, a bigger number of days of medical care for healing determine the framing of the offence of violence in an article of the Romanian Criminal Code, which provides for a greater punishment for the perpetrator [11, 12].

It should be noted that the granted number of days of medical care for healing is not equivalent to the number of days of hospitalization, number of days of sick leave, or the total number of days for recovering. The number of days of medical care for healing is established according to the most severe injury and it does not represent the sum of the number of days of medical care for healing granted for each injury observed in the victim [11,13,14].

In order to assess properly the severity of a dental injury according to the forensic criteria of evaluation, collaboration between the forensic pathologist and the dentist is many times essential. Therefore, in practice there are many situations when the forensic pathologist relies on the medical information provided by the dentist who examines the victim. For this reason the examination in a dentist office of victims with traumatic dental injuries, recommended by the forensic pathologist is a priority and a professional obligation prescribed by law [15]. On the referral the forensic pathologist asks to be noted on the patient's diagnosis, therapeutic indications and, when necessary, the estimated price for the therapeutic procedures until recovery. According to all this information and also to the forensic examination itself, the forensic pathologist estimates the number of days of medical care for healing and can also clarify other aspects raised by the criminal investigation.

All the medical documents issued by the dentist who examines the victim are mentioned in the content of the forensic expertise, including the date of examination and the name of the dentist who performed the examination.

The indicative scale for the assessment of the gravity of traumatic dental injuries

The evaluation of the number of days of medical care for healing in the forensic practice is guided by an *indicative scale for evaluation of the gravity of the traumatic injuries*. However the provisions of the indicative scale are to be applied individually, taking into account the particular aspects of each case, including the comorbidities, psychosomatic condition, and individual reactivity. The scale is divided into types and subtypes of traumatic injuries,

[1] According to the article 193- *Hitting or other violence*: "Hitting or any acts of violence which cause physical suffering shall be punished by imprisonment from 3 months to 2 years or with a fine. The act by which traumatic injuries occur or the health of a person is damaged, whose severity is evaluated by days of medical care of maximum 90 days, is punished by imprisonment from 6 months to 5 years or with a fine".
Article 194- *Bodily injury*, provides that: "The act provided in art. 193, which caused any of the following consequences: infirmity; traumatic injuries or impairment of a person's health, which required, for healing, more than 90 days of medical care; serious and permanent aesthetic prejudice; abortion; endangering the life of the person, is punished by imprisonment from 2 to 7 years".

and provides for the number of days of medical care for healing which may be granted to each of them and also to their complications, including the permanent ones, such as infirmity. The indicative scale mentioned above contains a full chapter dedicated to dental injuries [13, 14].

Despite the fact that the indicative scale is a useful tool for the evaluation of the gravity of the traumatic injuries by means of the number of days of medical care for healing, each case should be evaluated individually, given that:

- Many times is difficult to establish from the very beginning the complete diagnosis of the dental injuries, i.e., many times, the diagnosis needs to be supported with laboratory investigations, particularly dental x-rays;
- Dental injuries may occur against the pre-existing pathological background of the victim (e.g. caries, periodontitis);
- Dental injuries may damage teeth with endodontic treatment, implants or dentures;
- In evolution of the dental injuries can occur various complications, some of them of a serious nature, such as bleeding and infection.

In the assessment of the number of days of medical care for healing the forensic pathologist should also take into account the fact that the evolution of traumatic dental injuries differs from one person to another.

Another important aspect in the assessment of the number of days of medical care for healing that it is mentioned in the indicative scale and shall be considered, relate to the necessity of dental implants after dental avulsion or dislocation [16, 17].

We present in the table below (table 1) the provisions of the indicative scale concerning the dental injuries, which mention various types of dental injuries and associated injuries of the soft tissues and the number of days of medical care for healing (DMC) which may be granted to each of them [18].

Table 1. Dental injuries and facial soft tissues injuries and the corresponding number of days of medical care for healing [18]

Traumatic lesion	Subtype	DMC	Posttraumatic complications (PC)	DMC (PC)	Permanent posttraumatic consequences (PPC)	Infirmity
Abnormal mobility*	1-3 teeth	7-8	Pulp necrosis	5-8	Mastication Affected	-/+ (only if it is significant)
	4-6 teeth	10-12	Avulsion of tooth vasculo-nervous bundle	7-9	Total loss of the teeth with effective dental prosthesis	+
	More than 6 teeth	20-25	Pulp Infection. Pulp necrosis. Post-implant complications	7-9	-	-
Contusion	1-3 teeth	0-1			Partial loss of teeth with the impossibility of effective prosthesis	-
	More than 3 teeth	1-3			Partial loss of teeth with effective prosthesis	-
Dislocation	With intrusion, 1-3 teeth	25-30				
	With intrusion, more than 3 teeth	25-30				
	With extrusion 1-3 teeth	25-30				
	With extrusion more than 3 teeth	25-30				
	Lateral	25-30				
Avulsion	Simple	10-14				

	After re-implantation	10-14				
	Need dental implant	20-25				
Dental ruptures	Partial, involving 1-3 teeth	10-12				
	Partial, involving more than 3 teeth	12-14				
	At the level of the neck of the tooth 1-3 teeth	12-14				
	At the level of the neck of the tooth more than 3 teeth	12-14				
Dental fractures	Crown penetrating	12-14				
	Crown, un-penetrating	12-14				
	Neck (cervical)	12-14				
	Root, 1/3 superior	10-12				
	Root, 1/3 middle	10				
	Root, 1/3 apical	10-12				
	Root, more than 3 teeth	14-18				
Lips	Hematic suffusions	1-3			Significant lacerations with lesions of other soft parts with vicious scarring, or affecting of mastication and phonation	Aesthetic prejudice
	Small wounds (up to 1 cm)	7-9				
	Large wounds (over 1 cm)	8-12				

**Note: Mobility is synonymous with post-traumatic dental dislocation*

In the table above we can observe that the number of days of medical care for healing is different for each type of dental injury and can be supplemented in case of complications. The table also mentions the consequences of the traumatic dental injuries with direct reference to infirmity. As showed previously, regardless of the number of days of medical care for healing, if the injury determines one of the permanent consequences mentioned in article 194 of the Romanian Criminal Code the offence is considered a serious bodily injury and it is punished accordingly [12, 19].

All these aspects are in fact the key to the drawing of clear, accurate conclusions to forensic expertise, which is a reliable scientific evidence in justice, for the benefit of the victim who must be compensated while, the aggressor must be sanctioned according to the provisions of the criminal law [16, 17, 20].

Assessment of the traumatic dental injuries in corpses

At least as important as the assessment of the dental injuries in living victims, in forensic practice is to identify the traumatic dental lesions in cadavers even if the examining the teeth of a corpse may be difficult in practice. The presence, type and location of traumatic dental lesions allow the forensic pathologist to establish the traumatic mechanism and, finally, the death mechanism [21].

Below we present some cases from the archive of the Oradea Forensic Medicine Department, which show the importance of the correct evaluation of the traumatic dental injuries for the evaluation of the traumatic mechanism:

- In a case of murder in the context of domestic violence in which the victim died due to electrocution, during the autopsy we found and described partial ruptures of crowns of incisors on both dental arches. The dental injuries were not accompanied by lip injuries. By collating these data we have excluded an active mechanism of hitting and concluded that the dental injuries occurred in the context of intense muscular contraction due to the electric current [22, 23].

- In a partially skeletonized corpse we found dental lesions on the upper arch consisting of dental avulsions and dislocations and comminutive fracture of the right maxilla. We did not observe dental injuries on the lower dental arch. Thorough analysis and interpretation of these injuries in conjunction with other investigations (imaging, spectrometry, etc.) allowed us to establish the death mechanism, namely a shot wound with the entry wound on the occipital region with paths through the base of the skull and exit wound at the level of the face. Note to this case that previous expertise have evaluated wrongly that the lesions at the level of the face (including dental) were produced by hitting with a hard, blunt object [24, 25].

- In a corpse found near a cattle stable in which were two stags, we found at the level of the face, corresponding to right naso-genian groove an elongated, vertical wound, of about 1cm length, with blood infiltration on edges, transfixiant, with paths in the right upper oral vestibule, right maxillary bone, reaching the cranial cavity through the ethmoid and sphenoid bones. The corpse showed multiple pathological teeth changes (periodontitis, dental caries, non- traumatic dental ruptures) but with no recent dental injuries that could be associated with the facial lesions. Corroborating police investigation data with the autopsy findings we concluded that the facial injuries were not the result of an aggression, how initially has been suspected, but were produced by a stag horn [26].

- A truck-driver was found dead in the cabin of his car, showing signs of minor cranio-facial trauma, and abnormal mobility of three incisors on the lower dental arch, with hematic infiltration at gum-level and in the lower lip. Based on the preliminary police investigation it was suspected that the truck driver was the victim of an aggression. The autopsy revealed, in addition to the signs of minor cranio-facial trauma, a large myocardial tumor complicated with acute myocardial infarction. In these circumstances the forensic pathologist excluded the hypothesis of an aggression and concluded that the cranio-facial injuries were produced by the fall of the victim inside the truck-cabin, before the moment of his death [27-29].

As it follows from the presented examples, the identification, description and interpretation of dental lesions is very important but sometimes also very difficult. On the one hand, appropriate equipment (e.g. x-rays equipment in the autopsy room) is missing for such an examination in almost all the forensic medicine institutions in Romania. On the other hand, there are situations in which in order to correctly evaluate and to determine the mechanism which produced the dental lesions or in cases where the identification of dead bodies on the basis of the dental formula is required [30- 34] the forensic pathologist needs the expertise of a dentist. Despite all these aspects, at present the forensic practice in Romania lacks a protocol foreseeing the collaboration between the forensic pathologist and the dentist in specific situations. These issues remain challenges to the Romanian forensic practice in the future.

CONCLUSIONS

In forensic practice the description and the interpretation of the traumatic dental injuries is important both in living and in dead victims. The forensic pathologist who examines a living or a dead victim showing traumatic dental injuries has the responsibility to accurately describe and evaluate the gravity of the injuries and also to establish the traumatic mechanism.

In many cases the forensic pathologist cannot elucidate all the aspects of a case involving dental injuries without having to consult with the dentist in an official setting, through the issuance of documents.

Correct evaluation of dental lesions can be challenging, especially during autopsy. In order to increase the correctness of the assessment of these injuries, it is necessary that the forensic institutions in Romania be equipped with specific equipment, especially with mobile X-ray device with which to carry out x-rays by a radiologist, which subsequently to be reviewed in collaboration with dentists. Also, the collaboration between the forensic pathologists and dentists must be officially regulated by means of a protocol in order to solve the problematic cases involving either living or dead victims.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interests.

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