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MECHANISM OF INJURY- A SIGNIFICANT COMPONENT IN EVALUATION OF MAXILLOFACIAL TRAUMATIC PATIENTS STATUS

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ABSTRACT:

Knowing the injury mechanisms is of extreme importance for correct diagnostic evaluation. Specific injury models can be related to exactly determine trauma mechanisms. Understanding the way of injury may be a key to solving the occult injuries. Thus, some life threatening injuries may be diagnosed without present clinical symptoms at the moment of examination.

Purpose: The aim of our study is to analyse the risk factors for arising of associated maxillofacial trauma injuries (AMFI)

Material and methods: A total of 352 traumatic patients were retrospectively and prospectively examined for the period 05.2005 - 12.2011, treated at the Department of Oral and maxillofacial surgery at the St. Anna University Hospital, Sofia, whereas AMFI were determined in 129 patients

Results: Our study results indicate that most often, RTA are a reason for a combined trauma at the age group of 20-29, followed by the age group of 30-39, and less in the age group of 40-49. The most often reasons for combined traumas are RTA(road traffic accident) and IPV(interpersonal violence), each of which has a relative share, significantly higher than the other reasons (x2, ð<0.001). Our study results indicate that following a RTA, the most common combined trauma is CrT - 31 patients, followed by muscular skeletal system trauma - 11, equal number of eye injuries and polytrauma – 4 patients, spinal cord trauma - 1, and more than one concomitant injury - 1. When analyzing the mutual relation between aetiology and combined trauma, the most common reasons are included (RTA and thrash) as well as combined traumas (neurosurgical, MSS trauma and eye trauma).

Conclusion: Data analysis in our study indicates that trauma mechanism is the most important factor that imposes the need of CT examination, especially in intoxicated and disorientated patients, as well as in unconscious patients.

Key words: maxillofacial trauma, etiology, mechanism

INTRODUCTION:

According to most studies, knowing the mechanism of injury is a significant component in evaluation of traumatic patients status [11, 17]. In case of falling from a height of 3 or more meters, there is a high risk of presence of spinal cord trauma, of long bones and pelvis trauma [16]. A RTA with anterior-posterior hit, as well as with incident at a sudden slowing down the car are also alarming. Therefore, diagnostics of some potential life threatening injuries (especially mediastinal) is based on: mechanism of trauma, radiography of the thorax or ultrasound examination. According to Perry [10, 11], clinical study and repeated radiography of the thorax are not so reliable in estimation of the thorax status, and the estimation of abdominal area status may also be too difficult, especially if the patient is unsociable.

Most studies confirm the thesis that brain injury is more likely at high energy traumas - RTA(road traffic accident), height traumas and also in cases of more serious facial skeleton injuries.

The aim of our study is to analyse the risk factors for arising of associated maxillofacial trauma injuries (AMFI) (factors - predicators for concomitant injuries presence)

MATERIAL AND METHODS

A total of 352 traumatic patients were retrospectively and prospectively examined for the period 05. 2005 - 12. 2011, treated at the Department of Oral and maxillofacial surgery at the St. Anna University Hospital, Sofia, whereas AMFI were determined in 129 patients.

RESUTS

In our study, we determined the following relations regarding the trauma mechanism.

1. Data analysis according to injury mechanisms and patients age at the moment of trauma

We analyse the mechanism of injury and patients' age at the moment of trauma

Our study results indicate that most often, RTA are a reason for a combined trauma at the age group of 20-29, followed by the age group of 30-39, and less in the age group of 40-49, but no significant differences are determined in patients distribution (x2, p=0.088) in the indicated age groups. Thrash is the combined trauma reason most often in the age group of 20-29, followed by 40-49, and less in the age group of 30-39, but no significant differences are determined in combined trauma patients distribution as a result of a thrash in the analysed age groups (x2, p=0.338) (Table 2).

Data analysis indicates that RTA is the more frequent

combined reason than IPV(interpersonal violence) in age groups of 20-29 and of 30-39, while in the age group of 40-49, thrash prevails, but no significant differences are determined in patients distribution according to the reason in each of the indicated age groups (x2, p>0.05).

Table 1. Data analysis according to injury mechanisms and patients age at the moment of trauma

Trauma aetiology	Age groups (years)							Total number
	<12	12-19	20-29	30-39	40-49	50-59	>60	
RTA	1	6	18	15	7	4	2	53
IPV	0	6	16	9	11	2	6	50
Employment	0	0	0	0	1	2	1	4
Sport	2	2	1	0	0	0	0	5
Fall	0	1	1	0	3	2	3	10
Falling from a height	0	0	2	1	2	0	0	5
Gunshot	0	0	1	1	0	0	0	2
Total number	**3**	**15**	**39**	**26**	**24**	**10**	**12**	**129**

Table 2. Distribution of trauma reasons per age groups

Trauma aetiology	Age groups			Level of significance
	20-29	30-39	40-49	
RTA	18	15	7	p=0.088
IPV	16	9	11	p=0.338
Level of significance	p=0.732	p=0.221	p=0.346	

2. Results according to associated trauma aetiology

The most often reasons for combined traumas are RTA and IPV(interpersonal violence), each of which has a relative share, significantly higher than the other reasons (x2, p<0.001).

Patients as a result of RTA are 53 (41.1%), of a IPV - 50 (38.8%), of an employment trauma - 4 (3.1%), of a sport trauma - 5 (3.9%), of a fall - 10 (7.8%), of falling from a height trauma - 5 (3.9%), of a firearm trauma - 2 (1.6%) (Table 3).

Table 3. Associated trauma aetiology

Combined trauma reason	Number	%	Level of significance
RTA	53	41.1	p<0.001
IPV	50	38.8	
Employment	4	3.1	
Sport	5	3.9	
Fall	10	7.8	
Falling from a height	5	3.9	
Gunshot	2	1.6	
Total number	**129**	**100**	

Our study results indicate that following a RTA, the most common combined trauma is CrT - 31 patients, followed by muscular skeletal system trauma - 11, equal number of eye injuries and polytrauma – 4 patients, spinal cord trauma - 1, and more than one concomitant injury - 1. Clinical material analysis indicates that after a thrash, the most common combined trauma again is CrT - 43 patients, followed by ophthalmology trauma - 3, and the other traumas – per one patient. The only combined trauma resulting from a sport trauma is CrT, and as a result of falling from a height, SCT and polytrauma – per two patients, and more than one concomitant injury – 1 patient (Table 4).

Table 4. Data analysis regarding the trauma aetiology and combined trauma type

Trauma aetiology	Combined trauma								Total number
	CrT	MSS	OPh	SCT	>1 CT	PT	ORL	A	
RTA	31	11	4	1	1	4	0	1	**53**
IPV	43	1	3	1	1	1	0	0	**50**
Employment	1	0	1	0	1	0	1	0	**4**
Sport	5	0	0	0	0	0	0	0	**5**
Fall	9	0	1	0	0	0	0	0	**10**
From a height	2	0	0	0	1	2	0	0	**5**
Gunshot	1	0	1	0	0	0	0	0	**2**
Total number	**92**	**12**	**10**	**2**	**4**	**7**	**1**	**1**	**129**

Legend: CrT – cerebral trauma, MSS – muscular skeletal system, OPh – ophthalmology trauma, SCT – spinal cord trauma, >CH – more than one combined trauma, PT - polytrauma, ORL – otorhinolaryngology trauma, A – abdominal.

3. Mutual relation between combined trauma and reason

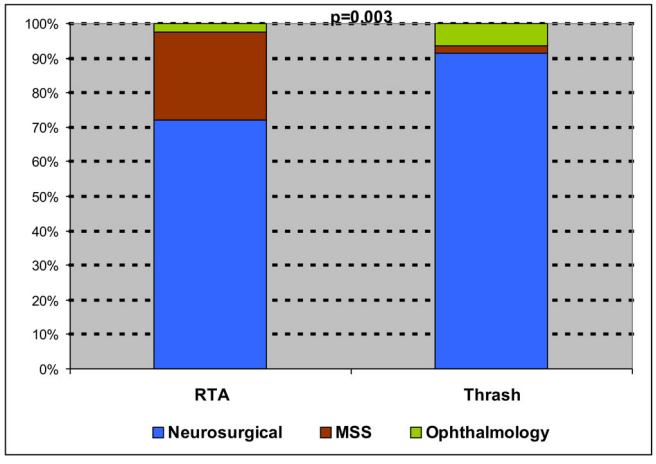
When analyzing the mutual relation between aetiology and combined trauma, the most common reasons are included (RTA and thrash) as well as combined traumas (neurosurgical, MSS trauma and eye trauma). Because of expected low frequencies in other combinations, there is a risk of results untrustworthiness.

Significantly higher relative share of combined MSS traumas was determined, resulting from RTA (x2, p=0.003). MSS traumas are not a typical consequence of a thrash, when usually neurosurgical and in some cases ophthalmology combined traumas occur (Table 5, Figure 1).

Table 5. Mutual relation between aetiology and combined trauma

Aetiology	Combined trauma			Level of significance
	Neurosurgical	MSS trauma	Ophthalmology	
RTA	31	11	4	p=0.003
IPV	43	1	3	

Fig. 1. Mutual relation between trauma reason and type of occurred combined trauma



DISCUSSION:

Patients that suffered as a result of an employment accident, are 3.1%. Patients are above 40 years of age. Possibility for this trauma is greatest in individuals that use tools or machines at work (1.5 to 7 times higher risk) [9]. Our study results indicate lower percentage compared to the study of Down et al. [4], who state that 5% of patients have suffered in such trauma, and higher compared to Lim's study [9] - 1.6%.

Clinical material analysis in our study indicate that 10 (7.8%) patients have suffered from falling (of their own height) and is lower compared to studies of Lim [9] (9.7%) and of Thoren [13] (19.2%).

Trauma from falling from a height, as a high energy injury mechanism, is a precondition for combined trauma presence. In our study, patients suffered from such a trauma, were 5 (3.9%). Compared to other authors, this percentage is lower - 6.5% [12,13].

Some authors have published interesting data, according to which ÑMFT in low energy injury mechanisms are 14% (thrash, fall) and 64% are in high energy injury mechanisms (RTA, trauma from falling from a height) [9]. Our study data analysis shows that thrash as aetiology fac-

tor for ÑMFT appearance follows right after RTA. Large number of traumas as a result of a thrash (as not so high energy mechanism) very likely determines the not so high ÑMFT incidence in our study (36.6%) compared to other studies. As a leading ÑMFT mechanism, Bryan Bell et al. [3] also indicate RTA - 44% (a little higher percent than in our study - 41.1); next come falling - 22%, thrash - 9%, employment accidents - 7%, sport accidents - 9%, other accidents - 3%, firearm traumas - 6%.

Down et al. [4] also report RTA as a main reason for trauma - 70% (much higher percentage compared to our data - 41.1), of which the largest number are motor vehicles drivers (42), followed by pedestrians (28), motorcyclists (22), passengers (10); trauma from falling from a height (21); thrash (6) and falling from personal height (4); bicyclers (3); sport trauma (1) etc. (4). This study shows presents of multisystemic traumas at RTA, including MFT, which is confirmed by our study as well.

Clinical material analysis shows that MFT at RTA are more serious compared to traumas obtained by other mechanisms of injury. The incidence of RTA and traumas caused by these, depend on many different factors: traffic regulations, roads status, drivers' abilities, good working order and type of motor vehicles etc. Alcohol abuse and motor vehicles drivers' tiredness play a major role as a reason for these accidents and therefore various organizations lead campaigns for RTA prevention. In these accident reasons, concomitant trauma presence is more likely according to our study – in 65%. RTA are the reason for severe MFT, often combined with other organs and systems traumas, which lead to life threatening statuses. In order to decrease the RTA risk, it is important to observe safety standards regarding seat belts, limits for use of alcohol and sedating drugs, standards for motor vehicle safety.

Combined MFT may result from various injury mechanisms, having in mind increasing global problems of today's world – intensive migration and increasing violence. The most common mechanisms according to Vetter et al. still are RTA and thrash [14], which is confirmed by our study as well.

Our study indicates that ÑMFT result mainly from RTA (suddenly turning down the speed), falling and thrash (hit by blunt object in head and face). In ÑMFT with eye injury, optical nerve injury mechanism in maxillofacial fractures may be a result of a nerve compression or laceration by bone fragments, of neurilemma haematomas, of nerve contusion following an oedema and of supplying vessels secondary compression [1]. Nerve may be injured in its entire length, whereas the most common trauma is intracranial injury, and its early diagnostics is of extreme importance for prognosis and result of treatment. Nerve may be injured in stretching, contusion or in reflected forces along relatively dense and robust canal. Initial hit starts a cascade of mediators which in turn cause secondary vasospasm, vasoocclusion, oedema and necrosis. This happens more frequently when trauma force is transferred to optical canal and as a result, n.opticus is injured, and neuronal compression occurs, together with vasoocclusion and a localized form of compartment syndrome, which is initially reversible, but after that leads (progresses) to arterial obstruction and irreversible thrombosis [15]. Neurilemma haematoma formation and nerve transaction are more rarely observed. When there is an overall nerve transaction, no treatment is possible, unlike the other injury mechanisms, in which early treatment may lead to better prognosis for the patient's vision. Clinically various type of n.opticus injuries are hard to determine and therefore ophthalmology consultation and CT or MRI examinations are required.

Specific injury models are related to exactly determined injury mechanisms and today are well known: in trauma from falling from a height, there is a great risk for SCT presence, of long bones and pelvis fractures; RTA with anterior-posterior hit (whiplash hit), as well as sudden turning down the speed (even at low speed) are critical for thoracic trauma (mediastinum compression, aorta dissecation), internal organs injuries (supplying vessels laceration). High energy fractures are problematic regarding to neurology injuries (mainly CrT). In these, there is a real risk of intracranial pressure increase, dura laceration, rhinoliquorrhea, ophthalmology injuries, frontal sinus damage etc. [10, 11].

Forces leading to bulb injury, may not affect periorbital tissues and thus patient vision threatening injury may be omitted. Clinical material analysis in our study indicates that penetrating injuries may be a result of small projectiles during an accident, for example. Special attention must be paid in traumas caused by broken glass, wooden or metal fragments, as well as in examination in eyelid trauma or periorbital laceration. Rupture and bulb perforation with presence of foreign body should be considered in all craniofacial traumas. Because of close relation between structures in anterior and middle cerebral fossa and orbit (divided only by a thin bone barrier), intracranial injury should be suspected in all penetrating orbital injuries. Suspecting of such trauma (penetrating cerebral and eye trauma) is based on the anamnesis, of injury mechanism and of clinical examination result.

This study results indicate that concomitant traumas must be suspected in all high energy traumas. According to Thoren et al. [13], concomitant trauma was diagnosed in three of 4 patients falling from a height, and in two of three patient suffered in a RTA, which confirms concomitant trauma incidence in high energy injury mechanisms that may cause life threatening conditions.

Our examination data confirm bibliographic data that AMFI(associated maxillofacial injuries) are more frequent as a result of high energy traumas. Most combined traumas result from RTA (41.1%), second are AMFI resulted from not so powerful mechanisms – thrash, employment trauma, sport trauma. High percentage of combined maxillofacial trauma obtained as a result of a thrash (38.8%) is impressive and may be related to increasing aggression and value system violation in modern society. In multiple injuries patients and in polytrauma patients, primary mechanisms of injuries are RTA, followed by falling from a height.

There is an interesting opinion of some authors who have determined that cervical spine injuries are more common in RTA [7]. The typical patient with combined cervical and MFT, according to Hackl åt al. is a male, about 40

years old, and has suffered by high-energy trauma – usually RTA [7].

High-energy facial skeleton traumas (such as RTA) cause more frequent cervical spine injury in comparison to traumas caused by low-energy mechanism. Most cervical spine injuries that come together with mandibular fracture are caused by forces exercised directly or indirectly by facial skeleton towards neck. It is considered that mandibular fractures are more often connected to upper cervical part injuries, while mid-face fractures – with lower cervical part. This is related to cervix flexion and/or extension at the moment of strike [8].

A banal frontal laceration in adult patient, obtained as a result of a trivial fall, may be the only indication for cervical spine injury [8]. Clinical diagnosis is basically difficult because of the fact that cervical spine traumas are often not manifested by local clinical signs, therefore authors emphasize that radiography examination in MFT patients must be compulsory [12, 13].

Grover & Antonyoshyn [6] indicate that excluding a cervical trauma in some patients may be difficult – for example patients under influence of drugs (seducing agents), alcohol, uncooperative, irresponsive patients, patients with changed mind. Cervical spine injuries affect the MFT treatment, therefore excluding of this trauma is required before performing any therapeutic measures (in 10-15% of polytrauma patients, cervical trauma is determined). Both detailed anamnestic information and trauma mechanism evaluation are of great importance as a warning factor indicating to a possible SCT(spinal cord trauma) [10].

Our examination results indicate comparatively low ÑMFT with SCT incidence (1.6%), whereas obtained data are not in conformity with most studies that underline high incidence of these traumas, but should not be neglected, and have to be accepted as existing in any traumatic patients until the opposite is determined.

Knowing the injury mechanism is extremely important in MFT diagnostics and treatment, as it is possible the patient to be directed to the MFS wards, and sometime interhospital transfer is required in case that the only visible injury is MFA trauma.

It is important to know that about 15% of all injuries (especially of spinal cord and muscular skeletal system) may be omitted during the initial examination and in status estimation [2, 5]. Data show that surprisingly, even a weak sudden turning down the speed (in RTA) has the potential to cause death as a result of mechanisms mentioned (internal organs may be torn partially or totally from their supplying vessels). A large part of these injuries is not determined immediately and remain hidden for hours or days until diagnosed. SCT(spinal cord trauma) for example are related to a larger percentage to the mandible fracture cases and are more common in RTA

CONCLUSION:

We determine that multiple trauma is possible to a largest extent in the following injury mechanisms: height trauma – falling from more than 3 meters; RTA, in which the passenger was found outside the car in case there is a dead passenger; hit pedestrian; RTA in motorcyclist or bicycler; high speed RTA; RTA in which there is a serious car deformation, as well as in case of disturbed taking the victims outside the car. The concept of high energy trauma (except trauma from falling from a height) is hard to define. Thrash and RTA include a large number of heterogeneous conditions.

Data analysis in our study indicates that trauma mechanism is the most important factor that imposes the need of CT examination, especially in intoxicated and disorientated patients, as well as in unconscious patients.

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