

# Occurrence and Types of Associated Injuries in Patients with Maxillofacial Fractures

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**Abstract:** *Introduction* Severity and complexity of combined maxillofacial traumas require not only multidisciplinary approach, but prevention of this trauma is also of extreme importance, as this may reduce direct and indirect social economic losses. Understanding the trauma reasons, severity and age structure may support clinical priorities determination, increase treatment effectiveness, and also may achieve certain trauma prevention. Initial estimation and trauma treatment in CMFT patients must be performed per ATLS algorithm. **Purpose** The aim is to identify the aetiology, occurrence, clinical characteristics of maxillofacial combined traumas types, and severity of associated injuries outside the facial region in patients diagnosed with facial fractures. **Material and Methods** A total of 352 traumatic patients were retrospectively and prospectively examined for the period of 6 years (05.2005 - 12.2011), treated at Department of Oral and Maxillofacial surgery at the St. Anna University Hospital, Sofia, on grounds of the accurately kept hospital documents in conformity with accepted standards and with ethical requirements for performing such studies. **Results** Associated injuries were observed in 129 patients (36%). The most common associated injury was head trauma (71.3%), followed by orthopaedic (9.3%), ophthalmologic (7.8%), spinal cord injuries (1.6%), and abdominal (0.8%), otorhinolaryngology (0.8%) injuries. Multiple associated injuries were observed in 3.1% and polytrauma in 5.4%. In combined maxillofacial trauma (CMFT), the most common maxillofacial fracture is lower jaw fracture (46.5%), followed by zygomatic bone trauma (34.9%) and nasal bones trauma (21.7%). The occurrence of associated injury correlated significantly with trauma mechanism and fracture type; high-speed accidents and severe facial fractures were significant predictors of associated injury. Alcohol plays a key role in maxillofacial trauma appearance, whereas the alcohol relation is significant with interpersonal injuries (42%), with falling (20%) and with motor vehicle accidents (5.7%). **Conclusion** Applying of multidisciplinary approach (anaesthesiologists, neurosurgeons, abdominal surgeons, traumatologists, maxillofacial surgeons) in traumatic patients provides optimum results and the best possible outcome in their treatment.

**Keywords:** maxillofacial trauma, associated injuries, combined trauma, multiple trauma, polytrauma

## 1. Introduction

MFT is still no doubt a challenge, especially in early treatment stages in combined trauma patients(1). These injuries are a common pathology, which every physician can meet, regardless of the place they work. MFT can be accompanied by various injuries that affect other organs and systems. Both treatment of the main trauma and of MFT have passed significant development during the last years. In treatment of CMFT patients, it is possible a large amount of clinical dilemmas to arise and must be taken into account basing on bibliographic data and on our collective experience. Advanced Trauma Life Support is determined as a golden standard and is based on well known principles, but strict adherence to the protocol may have its disadvantage in presence of a combined MFT(2,3). Difficulties in treatment of these patients may arise in presence of a small or a large MFT and both oral surgeon and MFS must be aware that possible problems may appear, regardless of injury severity. Maxillofacial trauma is one of the most interesting aspects of oral and maxillofacial surgery. Regardless of advance in tissue healing understanding, in new biomaterials development and in surgical techniques improvement, initial estimation, relevant time and result of facial injuries treatment, especially on early stages, remain difficult tasks in patient treatment. Suitable and due MFT treatment is interesting and represents a challenge especially in high energy traumas, where there are many injuries and leading trauma may affect other anatomic area. Then, leading trauma will have priority. In these circumstances, various clinical dilemmas arise, some of which may be predictable. For example, at the early stages of clinical estimation, injury

under the clavicle may significantly affect the MFI treatment and conversely, MFT may affect other injuries treatment(4).

In many cases there are no clear response in MFT treatment and management will depend on particular circumstances (available resources, clinical experience, other injuries presence, need of transfer). Following a determined protocol is often very convenient, but this may have its disadvantages, on some of which there are still opened discussions.

Lack of data in Bulgarian bibliography during the last decades regarding the trauma dynamics, in particularly CMFT, in terms of decentralization of emergency medical aid directed to decentralization of hospital cares) gives us reasons for a profound problem elaboration.

The recently published international literature contains several investigations dealing with associated injuries in patients who have sustained facial injuries in general and facial fractures in particular. However, most of these studies have focused on a sole type of associated injury, such as cervical spine injury or brain injury. Other studies have included associated injuries more extensively, but only in association with a particular type of facial fracture, such as mandibular fracture or pan-facial fracture. Comprehensive analyses of associated injuries in patients with facial fractures are scarce.(4)

**The aim** of the study is to make an estimation regarding the aetiology, occurrence, clinical characteristics of maxillofacial combined traumas types, and severity of

associated injuries outside the facial region in patients diagnosed with facial fractures.

## 2. Materials and Methods

A total of 352 traumatic patients were retrospectively and prospectively examined for the period 05.2005 - 12.2011, treated at the MFS Ward at the St. Anna University Multidiscipline Active Treatment Hospital in Sofia, whereas CMFT were determined in 129 patients.

### 2.1 Place of Study

Department of MFS at "St. Anna" Hospital, Sofia. "St. Anna" is hospital that serves a large randomized population of patients – city and rural population from Sofia and district of Sofia; it has the suitable ward structure (emergency gate), capacity and volume and the study has a representative extract. Both accidentally appeared patients and specially directed to our clinic patients from other wards were treated.

### 2.2 Material

129 CMFT patients were studied retrospectively (disease history) and prospectively for a period of 6 years (05.2005-12.2011) on grounds of the accurately kept hospital documents in conformity with accepted standards and with ethical requirements for performing such studies.

**Criteria for patients inclusion :** As a combined maxillofacial trauma we determined the simultaneous injury of two or more anatomical areas, one of which is compulsory MFA. In most of the patients, together with facial and maxillary bones fractures, there are soft tissues injuries as well (superficial abrasion, excoriation, contusion, lacerations). In the presence only of soft tissues injuries in MFA, without affection of facial and maxillary bones in multiple injuries patients, their processing in performed at the emergency ward of the hospital or in the ward where the patient was admitted. Concomitant injuries are identified per type and per affected areas. Anatomic areas with combined trauma in facial and maxillary bones fractures are classified as follows:

1. Brain trauma;
2. Thorax;
3. Abdomen;
4. Spinal column;
5. Skeletal muscular system;
6. Eye injury.

Patients that have had two or more injuries, affecting at least two regions, and of these injuries, at least one is life threatening, are classified according to the international standards as polytrauma patients. While the other patients with more than two injuries (affecting at least two anatomical areas) and without life threatening injuries, are determined as multiple trauma patients. The collected information was analysed according to personal details – age (at the moment of trauma) and gender of the patient; injury mechanism; type of obtained MF trauma, type of concomitant trauma and treatment performed, as well as

time from obtaining the trauma until performing the treatment in our clinic.

### 2.3 Methods

#### 1. Diagnostic

- a) *Clinical*
- b) *Paraclinical – radiography (orthopantomography, modified Hirz, perinasal cavities, axial radiographies), CT, MRI, ultrasound, laboratory examinations.*
- c) Conventional radiography examination was performed in 78 (60.5%) of studied patients, in 10 (7.8%) of them – a CT examination, and in 41 (31.8%) – both imaging diagnostics methods.
- d) Laboratory blood examinations were performed of all patients, and those in need of a surgical treatment, additionally necessary examinations were performed – biochemistry, coagulation status, ionogram, acid alkaline reaction, urine analysis.
- e) *Consultations of combined trauma patients of adjoining specialties*, related to diagnostics and treatment – neurosurgeon, ophthalmologist, traumatologist, abdominal surgeon, anaesthesiologist.
- f) Consultations with adjoining specialties were performed, as follows: neurosurgeon - 109 (84.5%), ophthalmologist - 18 (14%), traumatologist - 21 (16.3%), abdominal surgeon - 11 (8.5%), ENT – 3 (2.3%).
- g) Therapeutic – per ATLS, soft tissue injuries processing, temporary immobilization, definitive fragment reposition and fixation, reconstructive interventions.
  - For the statistic data analysis, a software application was used - SPSS Statistics 15.0. For a level of significance, when zero hypothesis is rejected,  $p < 0.05$  was chosen.
  - Having in mind the primary aim and tasks of the study, as well as data volume and type, the following statistical methods were applied:

1. **Descriptive analysis** – in a table, the frequency distribution of examined symptoms is presented, split per groups of study.
2. **Cross tabulation** (mutual frequency distributions of two quality variables) – to look for a relation between category symptoms.
3. **Fisher's exact test and  $\chi^2$  criterium** – to look for statistical dependency of quality variables.
4. **Kolmogorov-Smirnov test** – to check distributions for normality.
5. For a **graphical analysis** and graphic presentation of results, Microsoft Excel, 2007 was used.

## 3. Results and Discussion

Depending on the age at the moment of trauma, patients are divided to the following groups: children – below 12 years of age, teenagers from 12 to 19 years of age (young people) and adults, 20 and above years old. Results of this study indicate that CMFT is observed at the age from 9 to 86, with average age of  $35.24 \pm 15.95$  years. Statistically significant unequal CMFT patients distributions was determined, according to the age group, whereas the

highest is relative share of those in the age group 20-29, and the lowest – in the age group below 12 years of age ( $x^2$ ,  $p < 0.001$ ) (Table 1).

**Table 1.** Patients distribution per age (n=129)

Age group	Number (%)	Level of significance
<12 years	3 (2.3)	$p < 0.001$
12-19 years	15 (11.6)	
20-29 years	39 (30.2)	
30-39 years	26 (20.2)	
40-49 years	24 (18.6)	
50-59 years	10 (7.8)	
>60 years	12 (9.3)	
<b>Total number</b>	<b>129 (100)</b>	

### Comparative data analysis and discussion

The results obtained by us are identical to those in most studies [4,5,6,7] that these traumas affect mainly young people. In their study, Thoren et al. [4] indicate average age of 38.7 years, the most affected group - 20-29 years (23.4%) and 0.8% of patients are children. Gassner [7], in turn, indicate that 50% of patients examined by them were at the age between 10 and 37 years and 30% were between 38 and 54 years old. Down et al. [6] have performed a one year study that included 1088 traumatic patients, of which 658 were accepted in a hospital, and 161 MFT patients (15%). The most affected group were patients about 17 years of age. Results of this study coincide with most

studies, indicating that the most affected group is at the age between 20 and 40 years of age (in our study - 65 patients or 50.4%), that includes the most active age among the population and determines the large direct and indirect social economic losses as a result of the trauma and its treatment.

### Age structure of the patients and type of combined trauma

Clinical material analysis indicates that significant differences in age group distribution are only determined in cerebral traumas after a carefully data interpretation, but in any case we can't make the conclusion that these traumas are typical for the age group of 20-29 and are not typical for those below 12 years of age, because as a rule, our patients are not equally distributed according to the age, i.e. as a rule, there were most patients between the age of 20-29 and less patients below 12 years of age, and the respective distribution of cerebral traumas were expected as well. In all the other traumas, which are with low incidence, data are presented merely for information and it is hard to make any conclusions or summarizations. After the data analysis, a significant difference is determined in CrT distribution per age groups, whereas the most frequent they are in the age group 20-29 and the most rare – in the age group below 12 years. This patient distribution corresponds to distribution of total number of patients (Table 2).

**Table 2:** Distribution of patients per age and per trauma type

Combined trauma	AGE GROUP (years)							Level of significance
	<12	12-19	20-29	30-39	40-49	50-59	>60	
Cerebral	2	12	27	18	17	6	10	$p = 0.001$
MSS trauma	0	1	4	5	1	1	0	$p = 0.176$
Ophthalmologic	0	0	3	0	3	2	2	$p = 0.940$
Spinal cord	0	1	1	0	0	0	0	-
More than 1 concomitant injury	0	0	1	1	1	1	0	$p = 1.000$
Polytrauma	1	1	2	2	1	0	0	$p = 0.931$
ENT	0	0	0	0	1	0	0	-
Abdominal	0	0	1	0	0	0	0	-

### Data analysis as per the patient's age and MFT type

Results of our study indicate that per this index, there is no significant distribution of patients per group age or per MFT number. In table 3, the information we collected is presented. There is no MFT that to be typical for a certain age group. In bibliography [9], it is stated that dentoalveolar traumas are more typical for younger patients in comparison with the older patients, which was not confirmed by our study. After data analysis, it was determined that the most frequent fracture in the age group of 20-29, is the lower jaw fracture – 23, followed by the zygomatic bone fracture - 17, multiple MFT - 9, nasal bones fracture - 7, orbit and upper jaw fracture - per 4, and dentoalveolar - 1.

**Table 3:** MFT distribution per age groups and type of MFT

MFT	AGE GROUP (years)							Total number
	>12	12-19	20-29	30-39	40-49	50-59	>60	
Upper jaw	0	1	4	5	3	0	2	15
Lower jaw	1	7	23	15	9	3	2	60
Zygomatic bone	0	3	17	7	10	2	6	45
Orbit	0	3	4	0	3	4	1	15
Nasal bones	2	3	7	7	3	1	5	28
Multiple MFT	0	1	9	6	5	0	2	23
Dentoalveolar	0	0	1	2	2	2	0	7
<b>Total number</b>	<b>3</b>	<b>18</b>	<b>65</b>	<b>42</b>	<b>35</b>	<b>12</b>	<b>18</b>	<b>193</b>

**Data analysis according to the patients' gender**

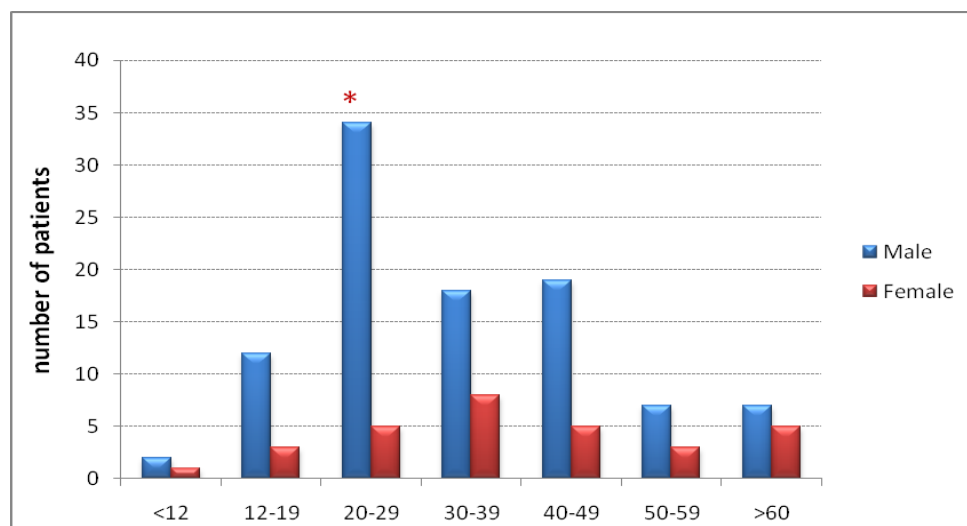
Clinical material analysis indicates that 99 (76.7%) of patients examined by us, are male, and 30 (23.3%) are female, whereas difference between genders is statistically significant ( $\chi^2$ ,  $p < 0.001$ ).

In the male group, there is significantly higher relative share of those of age 20-29 years ( $\chi^2$ ,  $p < 0.001$ ). The highest relative share in the female group is of those aged 30-39 years (Table 4, figure 1).

**Table 4:** Patients' distribution per age and gender (n=129)

Age group (years)	<12	12-19	20-29	30-39	40-49	50-59	>60	Total number (%)	Level of significance
<b>Male (number) (%)</b>	2 2.0	12 12.1	34 34.3	18 18.2	19 19.2	7 7.1	7 7.1	99 100	$p < 0.001$
<b>Female (number) (%)</b>	1 3.3	3 10.0	5 16.7	8 26.7	5 16.7	3 10.0	5 16.7	30 100	

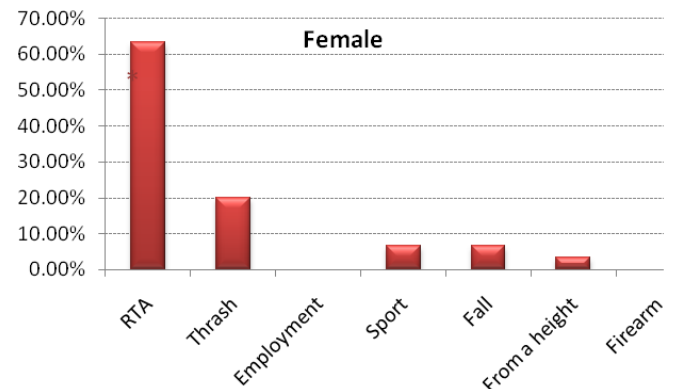
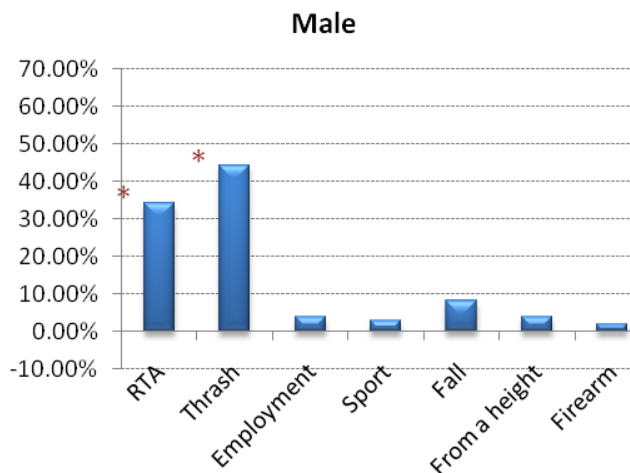
The indicated by us results correspond to bibliography data for the exclusive prevailing in these trauma in male patients. Gassner [9] indicates a distribution of 2:1 in favour of male patients, and according to Down et al., it is 3:1 [6]. In his study, Thoren [4] also emphasizes on serious male patients prevalence - 79.3%.

**Figure 1:** Patients' distribution per age and gender (n=129)

Correlation analysis according to combined trauma aetiology and patient's gender. Results of this study indicate that the most frequent reason for CMFT in male patients is thrash (in 44.4% of cases), followed by RTA (in 34.4% of cases), and these reasons significantly prevail above the others ( $\chi^2$ ,  $p < 0.001$ ). The main CMFT reason in female patients is RTA, significantly distinguished from other reasons ( $\chi^2$ ,  $p < 0.001$ ) (Table 5, Figure 2).

**Table 5:** Correlation analysis – trauma aetiology and patient's gender

Reason for combined	Male			Female		
	Number	%	Level of significance	Number	%	Level of significance
RTA	34	34.3	p<0.001	19	63.3	p<0.001
Thrash	44	44.4		6	20.0	
Employment	4	4.0		-	-	
Sport	3	3.0		2	6.7	
Fall	8	8.1		2	6.7	
Falling from a height	4	4.0		1	3.3	
Firearm	2	2.0		-	-	

**Figure 2:** Comparative analysis – trauma aetiology and patient's gender**Data analysis according to the type of combined trauma**

This study indicates that the higher relevant share have the neurosurgical combined traumas (71.3%), and the lowest - SCT, ENT and abdominal traumas (1.6%, 0.8%, 0.8%, respectively), whereas the difference is statistically significant ( $\chi^2$ ,  $p<0.001$ ) (Table 6).

**Table 6:** Patients' distribution according to the type of combined trauma (n=129)

Combined trauma	Number	%	Level of significance
Cerebral	92	71.3	p<0.001
MSS	12	9.3	
Ophthalmologic	10	7.8	
Spinal cord	2	1.6	
More than one concomitant injury	4	3.1	
Polytrauma	7	5.4	
ENT	1	0.8	
Abdominal	1	0.8	

**Comparative data analysis and discussion**

Patients with more than one concomitant injury are (3.1%) and as a percentage are less in comparison with other studies - Thoren et al. [4] inform about 10%.

In this study, neurosurgical injuries vary from commotion to a depression skull fracture. In cerebral traumas, the most common is commotion (in 76.1% of the cases), followed by a contusion (18.5%) and skull fracture (5.4%), whereas difference in relative shares is statistically significant ( $\chi^2$ ,  $p<0.001$ ).

Regarding the MFT with SCT occurrence, there are different data in bibliography – from 1 to 6% [10], but there are still doubts regarding the real significant statistic and epidemiology relation between these [11]. Results of our study are close to the most studies lower border - 1.6%, which is similar to Davidson's study [12], according to which, about 1.3% of MFF have a concomitant cervical spine injury. Most studies inform about percentages between 0.8 and 3.7% [13, 14, 15]. Similar to brain trauma, cervical spine injury must be suspected in every MFA fracture patient. Hackl et al. [16, 17] have published data for 4907 cervical spine



trauma patients and have determined that 2.1% have a concomitant MFI. By increasing the cervical spine injury severity, risk of MFT increases. Authors conclude that in cervical spine trauma patients, there is "a small but real risk of facial injury presence". Mandibular fractures present a larger risk of such concomitant trauma presence - in about 10% of mandibular fractures [16], and according to other authors - 2.6% [18], which is confirmed by our study as well. In bibliography, data are presented for a decreased SCT risk in younger patients, in female, in lack of CrT, as well as in patients with isolated teeth traumas or with soft tissue facial injuries [16]. There are two regions with risk of injury in case of mandibular fracture: C1, C2 and C5, C6, C7 [18]. Regarding the cervical spine injuries diagnostics, this trauma must be clarified in all mandibular fracture patients as a result of a high energy trauma.

MFF concomitant eye injuries frequency vary from 3 to 67%, according to Gossman, Roberts & Barr's study [19], and according to our study - 7.8%. After analyzing data in our study, it was determined that risk for presence of such injuries is high in a trauma that affect orbital skeleton, as well as in presence of significant soft tissue injuries periorbitally. In present study, eye injuries, as a concomitant trauma in CMFT, are observed in 10 of patients studied by us (7.8%), whereas three of them had a penetrating bulb trauma connected to a unilateral definitive loss of vision. These traumas aetiology varies from high energy trauma sources (RTA) to traumas with not such a big force (thrash). After the clinical material analysis, a conclusion was made that it is important a consultations with an ophthalmologist to be performed in these patients preoperatively not only in order to prevent complications regarding fractures treatment, but also because of the fact that successful treatment of this traumas requires early identification and immediate adequate intervention by the ophthalmologist. In patients that are unconscious (during the anaesthesia or resulting from a CrT), examination is performed right after the patient is able to communicate. Examination of vision, as well as light and colours perception, are the most commonly used clinical tests for recognizing loss of vision [20]. For the final result, close cooperation between ophthalmologists and maxillofacial surgeons is extremely important during the examination and treatment of orbital

traumas patients. Knowing about such a possible trauma and its recognition in due time are of extreme importance for improving the prognosis. After analyzing the data in our study, it was determined that abdominal trauma in one patient (0.8%) is the only concomitant injury, and in polytrauma patients, it is observed in three of them. Abdominal trauma includes liver, kidneys, spleen and intestines injury.

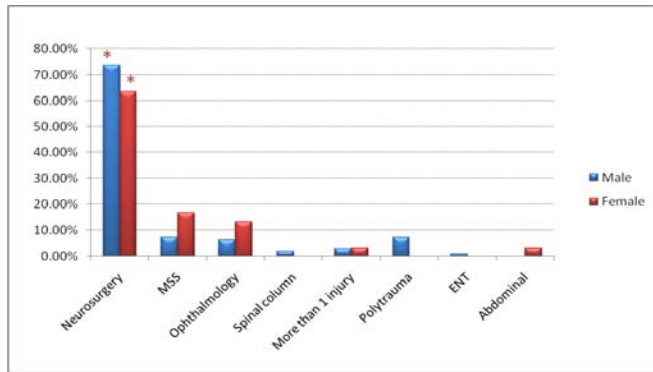
According to bibliographic data, various traumas refer to the thoracic traumas, varying from atelectasis to respiratory distress syndrome in adults, and to cardiac injuries - from a heart contusion to pericardial tamponade. Combined traumas of such nature were not observed in patients studied by us. Data from Haug et al. study [21] that in 5% there is an abdominal or thoracic trauma, in 16% - muscular skeletal system injury, in 4% - ophthalmology injury, differ from data in our study. In comparison, our results indicate a higher percentage in eye injuries - 7.8, and lower in MSS traumas - 9.3; in abdominal trauma - 0.8. According to our study data, muscular skeletal system injuries and abdominal injuries are observed mostly in RTA. After analyzing the data in our study, we made the conclusion that thrash, leading to extremities fractures, rarely leads to a life threatening statuses, but is a reason for a long-term functional incapability.

#### Data analysis according to combined trauma and patients' gender

After clinical material analysis it was determined that the trend for a significant prevailing of neurosurgical traumas in both genders is preserved ( $\chi^2$ ,  $p < 0.001$ ) (Table 7, Figure 3). It is impressive that in female patients, muscular skeletal system traumas and ophthalmological combined traumas are twice more common compared to male patients (16.7 vs. 7.1% and 13.3 vs. 6.1%, respectively). In male patients, there are no abdominal combined traumas, and in female patients, there are no SCT, polytrauma and ENT trauma.

**Table 7:** Combined trauma distribution according to patients gender (n=129)

Combined trauma	Male			Female		
	Number	%	Level of	Number	%	Level of
CrT	73	73.7	p<0.001	19	63.3	p<0.001
Of MSS	7	7.1		5	16.7	
Ophthalmologic	6	6.1		4	13.3	
SCT	2	2.0		-	-	
More than one concomitant injury	3	3.0		1	3.3	
Polytrauma	7	7.1		-	-	
ENT	1	1.0		-	-	
Abdominal	-	-		1	3.3	
<b>Total number</b>	<b>99</b>	<b>100</b>		<b>30</b>	<b>100</b>	



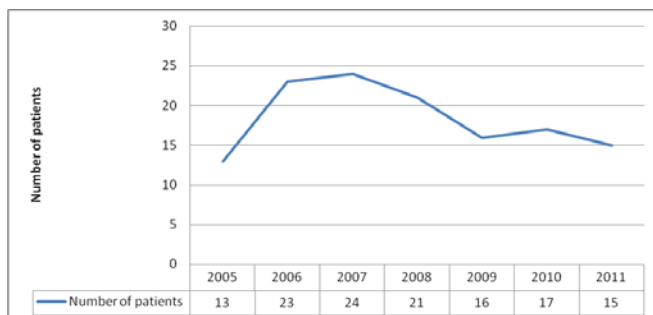
**Figure 3:** Combined trauma distribution per gender (n=129)

#### Data analysis according to combined trauma per years

With years, gradual CMFT decrease is determined (Table 8, Figure 4), but difference is not statistically significant, there is even no such trend, because the value of (p) is

**Table 8:** Combined trauma distribution per years

Year	Number	%	Level of significance
2005	13	10.1	p=0.441
2006	23	17.8	
2007	24	18.6	
2008	21	16.3	
2009	16	12.4	
2010	17	13.2	
2011	15	11.6	
<b>Total number</b>	<b>129</b>	<b>100</b>	



**Figure 4:** Combined trauma distribution per years

#### Maxillofacial traumas as a part of combined traumas

##### General data analysis as per MFT as a part of combined traumas

Results of our study indicate that in 106 (82.2%) patients, there is one MFT, that comes together with the combined trauma. In 23 (17.8%), there are two or more MFT that come together with the combined trauma, defined as multiple MFT. It was determined that in 46.5% of combined trauma cases that engage the MFA, lower jaw takes part, followed by a zygomatic bone trauma - 34.9%, and nasal bones trauma - 21.7%. This trend of MFT distribution is also observed in single MFT. In multiple MFT, the most common are nasal bones traumas (65.2%) together with zygomatic bone traumas (60.9%), of lower (52.2%) and /of upper jaw (52.2%).

very high. When the (p) value is 0.05 or less, then zero hypothesis is rejected, where it states that there is no difference in distribution between individual groups, i.e. there is a significant difference between groups and that does not result from an accident but there is a reason; however, here it is much above 0.05, which means that this reduction in number of patients results from "free fluctuations". If there is a larger number of patients to compare with years, maybe more significant differences will be obtained, but on grounds of these results, no general conclusions can be made. The weak trend to CMFT reducing is very likely connected to measures directed to RTA decrease – speed limitation, use of protective belts, airbag presence, increases sanctions for driving in intoxicated state etc.

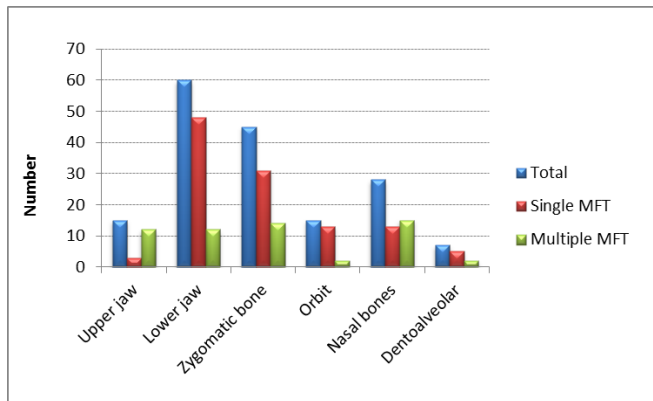
Significantly higher is the relative share of affected upper jaw, zygomatic bone (ZB) and nasal bones (NB) in multiple MFT in comparison to single MFT ( $\chi^2$ ,  $p < 0.05$ ). Significantly higher is the relative share of orbital fractures in single MFT compared to multiple MFT ( $\chi^2$ ,  $p = 0.005$ ) (Table 9, Figure 5).

This way a conclusion can be made that affection of UJ, ZB and nasal bones is more typical for multiple MFT. Our results are close to those of Haug et al. [21], who in their study inform about correlation of 6:2:1 of mandibular : zygomatic : maxillary fractures. Similar results were published by Down et al. [6], who also indicate as a most common MFT the mandibular fracture - 28.6%, followed by ZB and UJ fracture – equal percentages - 16.8%, nasoethmoidal - 11.8%, dentoalveolar - 9.3%, orbital - 6.8%; Thoren et al. [4] - 33.4% mandibular fractures; 31.7% zygomatic-orbital; 9.7% fractures that affect mid-face; 8.2% orbital fractures; 5.2% nasal bones fractures; 3% dentoalveolar, multiple fractures of facial and maxillary bones - 7%, upper facial third fractures - 1.8%; while Gassner [7] indicates the serious prevalence of midface fractures - 71.5%, mandibular fractures - 24.3% and frontobasal and orbital - 4.2%.

**Table 9:** MFT participation in combined traumas

MFT	MFT (total n=129)		Single MFT (n=106)		Multiple MFT (n=23)		Level of significance
	Number	%	Number	%	Number	%	
Upper jaw	15	11.6	3	2.8	12	52.2	p<0.001
Lower jaw	60	46.5	48	45.3	12	52.2	p=0.355
Zygomatic bone	45	34.9	31	29.2	14	60.9	p=0.005
Orbit	15	11.6	13	12.3	2	8.7	p=0.005
Nasal bones	28	21.7	13	12.3	15	65.2	p<0.001
Dentoalveolar	7	5.4	5	4.7	2	8.7	p=0.364

\* As a total, percents are more than 100, as in some patients there are more than one MFT.

**Figure 5.** Distribution of MFT, participating in combined traumas

#### Data analysis regarding maxillofacial traumas/gender

Results of this study indicate that in both genders, MFT as a part of combined traumas, are distributed in similar way ( $\chi^2$ ,  $p>0.05$ ) (Table 10).

**Table 10:** Distribution of MFT per gender

MFT	Male		Female		Level of significance
	Number	%	Number	%	
Upper jaw	13	13.1	2	6.7	p=0.271
Lower jaw	47	47.5	13	43.3	p=0.426
Zygomatic bone	38	38.4	7	23.3	p=0.096
Orbit	12	12.1	3	10.0	p=0.521
Nasal bones	19	19.2	9	30	p=0.157
Dentoalveolar	3	3	4	13.3	p=0.051

\* Percents are more than 100, as in one patient there may be more than one MFT.

#### Data analysis regarding trauma aetiology and MFT

After the clinical material analysis it was determined that in RTA, most often LJ is affected - 28 (16.5%), followed by zygomatic bone - 14 (8.2%), nasal bones - 10 (5.9%), orbit - 7 (4.1%), UJ - 6 (3.5%) and DA - 4 (2.4%). In thrash, again, the most affected is LJ - 26 (15.3%), followed by zygomatic bone - 19 (11.2%), nasal bones - 8 (4.7%), UJ - 5 (2.9%), orbit - 3 (1.8%) and DA fractures - 1 (0.6%) (Table 11).



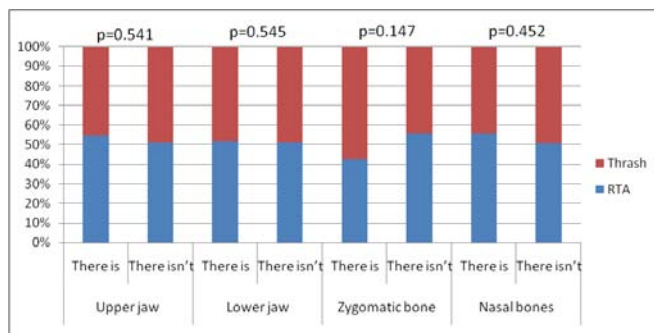
**Table 11:** Data according to trauma aetiology and MFT

Trauma aetiology	MFT (total for 129 patients)						Total number	Multiple MFT (in 23 patients)
	UJ	LJ	ZB	Orbit	NB	DA		
RTA	6	28	14	7	10	4	69	7
Thrash	5	26	19	3	8	1	62	9
Employment	0	0	3	2	1	0	6	1
Sport	0	1	1	0	3	0	5	0
Fall	1	1	5	2	3	1	13	1
From a height	3	4	2	0	2	0	11	4
Firearm	0	0	1	1	1	1	4	1
<b>Total number</b>	<b>15</b>	<b>60</b>	<b>45</b>	<b>15</b>	<b>28</b>	<b>7</b>	<b>170</b>	<b>23</b>

This study indicates that as a result of falling, the most common MFT is the zygomatic bone fracture, and as a result of falling from a height. In our study, only RTA and thrash were analysed as reasons for combined trauma, as well as MFT that affects upper and lower jaw, zygomatic bone and nasal bones, because of expected lower incidence and lack of authentication of results in the other reasons and MFT. Results after data analysis indicate that there is no mutual relation between trauma reasons (RTA or thrash) and bones affected in MFA ( $\chi^2$ ,  $p > 0.05$ ) (Table 12, Figure 6).

**Table 12:** Data about correlation of trauma aetiology/MFT

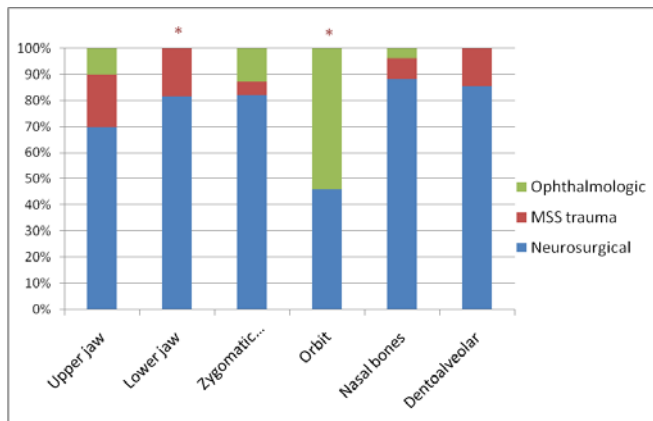
MFT	Upper jaw		Lower jaw		Zygomatic bone		Nasal bones	
	There is	There isn't	There is	There isn't	There is	There isn't	There is	There isn't
RTA	6	47	28	25	14	39	10	43
Thrash	5	45	26	24	19	31	8	42
<b>Level of significance</b>	<b>p=0.541</b>		<b>p=0.545</b>		<b>p=0.147</b>		<b>p=0.452</b>	

**Figure 6:** MFT distribution according to reason for their appearance**Data analysis regarding MFT and combined trauma**

During the analysis of mutual relation between MFT and combined traumas, only cerebral trauma, musculoskeletal system trauma and ophthalmologic combined traumas are taken into account, which are also the most common traumas. Results of our examination indicate that there is no mutual relation between fractures of upper jaw, zygomatic bone, nasal bones and dentoalveolar fractures with neurosurgical traumas, musculoskeletal system traumas or ophthalmologic combined traumas ( $\chi^2$ ,  $p > 0.05$ ) (Table 13, Figure 7).

**Table 13:** Data regarding MFT and combined trauma

Combined trauma	Neurosurgical		MSS trauma		Ophthalmologic		Level of significance
	There is	There isn't	There is	There isn't	There is	There isn't	
<b>MFT</b>							
Upper jaw	7	85	2	10	1	9	p=0.619
Lower jaw	40	50	9	3	0	10	p<0.001
Zygomatic bone	32	60	2	10	5	5	p=0.233
Orbit	6	86	0	12	7	3	p<0.001
Nasal bones	23	69	2	10	1	9	p=0.441
Dentoalveolar	6	86	1	11	0	10	p=0.501



**Figure 7:** MFT participation in combined trauma

After analyzing the clinical material it was determined that in distribution of lower jaw, orbit and orbital floor fractures, significant differences are observed. Results show that lower jaw fractures are typical for MSS traumas and are missing in ophthalmologic combined traumas ( $x^2$ ,  $p < 0.001$ ). In ophthalmologic combined traumas, more common are orbital fractures (mostly of orbital floor) ( $x^2$ ,  $p < 0.05$ ). The most common neurosurgical combined traumas are accompanied by lower jaw fractures in 40 patients (31%), of zygomatic bone in 32 patients (24.8%) and of nasal bones in 23 patients (17.8%), but no significant differences are determined. Our study results coincide with other authors (23).

#### Data analysis according to the combined trauma

##### Cerebral trauma as a part of multiple trauma / polytrauma

Results of this study indicate that in cerebral traumas (as a single concomitant injury), the most common is commotion (in 76.1% of cases), whose relative share is significantly higher than that of contusion of brain (18.5%), or skull

fracture (5.4%), whereas difference in relative shares is statistically significant ( $x^2$ ,  $p < 0.001$ ) (Table 14, Figure 8).

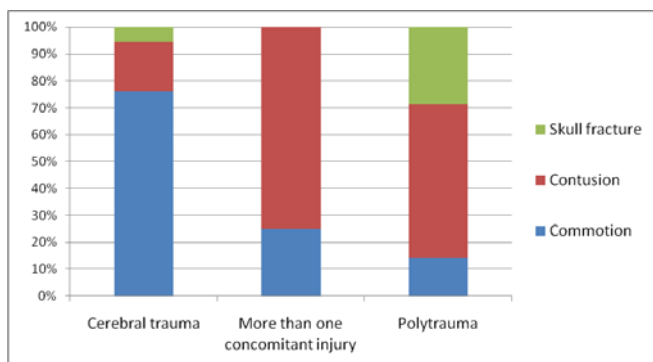
In cases of more than one concomitant injury, the more common CrT is cerebral contusion (75%), followed by a commotion (25%) and lack of skull fracture in analysed cases.

According to our study, in polytrauma, the most common is contusion (57.1%), followed by skull fracture (28.6%) and the most rare is commotion (14.3%). Data analysis indicates that no significant differences are determined in relative shares of commotion, contusion and skull fracture that accompany polytrauma ( $x^2$ ,  $p = 0.368$ ). No significant differences are determined also between various traumas – commotion, contusion and skull fracture, that occur in polytrauma ( $x^2$ ,  $p = 0.368$ ).

Results of this study indicate that in total of 103 (79.8%) of analysed patients, there is CrT, of which – commotion (72 patients, 55.8%), contusion (24 patients, 18.6%) or skull fracture (7 patients, 5.4%). It is determined that there is no CrT in 26 (20.2%) patients.

**Table 14:** Comparative data analysis related to type of combined trauma / CrT

Combined trauma	Commotion Number /%	Contusion Number /%	Skull fracture Number /%	Level of significance
Cerebral trauma (n=92)	70 (76.1)	17 (18.5)	5 (5.4)	$p < 0.001$
More than one concomitant injury (n=4)	1 (25)	3 (75)	-	0.317
Polytrauma (n=7)	1 (14.3)	4 (57.1)	2 (28.6)	0.368



**Figure 8:** Distribution of CrT as a part of combined traumas

Data analysis according to alcohol consumption during the trauma

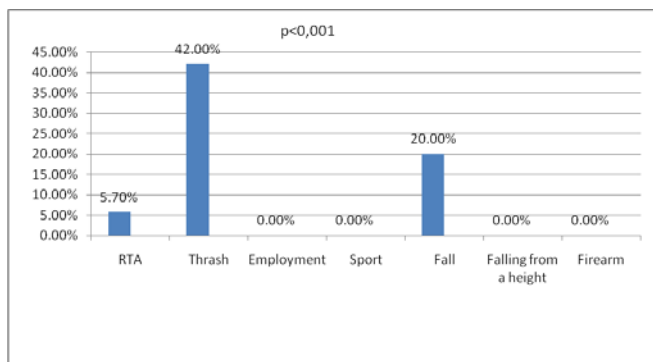
Of analysed 129 CMFT patients, 26 (20.2%) had used alcohol, whereas their relative share is significantly smaller than the number of those not using alcohol ( $x^2$ ,  $p < 0.001$ ).

Our study found a significantly higher relative share of male patients that had used alcohol, compared to those in female patients (24.2% vs. 6.7%) ( $x^2$ ,  $p = 0.026$ ). After clinical material analysis it was determined that alcohol as a risk factor that contribute to combined trauma, had a major influence in thrash, where 42% of patients had used alcohol. Alcohol was used in 20% of traumatic patients as

a result of falling and only 5.7% of traumas are a result of RTA (Table 15, Figure 9). Analysed patients with sport, employment, falling from a height or firearm trauma had not used alcohol. As analyzing the alcohol blood content is not a routine procedure (this analysis is performed in criminal cases, in RTA and in employment trauma), mainly clinical estimation, as well as data obtained by the patients are considered.

**Table 15:** Correlation of trauma aetiology / use of alcohol

Aetiology	Use of alcohol		Level of significance
	Yes	No	
RTA	3 (5.7%)	50 (94.3%)	p<0.001
Thrash	21 (42%)	29 (58%)	
Employment	0	4 (100%)	
Sport	0	5 (100%)	
Fall	2 (20%)	8 (80%)	
Falling from a height	0	5 (100%)	
Firearm	0	2 (100%)	



**Figure 9.** Use of alcohol in CMFT

Our study results indicate that no significant differences are determined in MFT distribution according to alcohol used by the patients ( $\chi^2$ ,  $p>0.05$ ) and shows that no significant differences are determined in combined trauma patients according to use of alcohol ( $\chi^2$ ,  $p=0.478$ ) (tbl. 16).

**Table 16:** Distribution of combined trauma patients according to use of alcohol

Combined trauma	Use of alcohol		Level of significance
	Yes	No	
Cerebral	22	70	p=0.478
MSS trauma	1	11	
Ophthalmologic	1	9	
Spinal cord	1	1	
More than 1 concomitant injury	0	4	
Polytrauma	1	6	
ENT	0	1	
Abdominal	0	1	

### Comparative data analysis and discussion

Our study confirms the role of alcohol influence as a co-factor for CMFT appearance. From the results obtained it is evident that patients with alcohol related injuries are often patients of MFS Wards. Our study regarding CMFT aetiology indicates the large percentage of injuries as a result of thrash - 38.8%.

Violence as a result of alcohol abuse is a reason for a large part of traumas obtained (42%). Injuries obtained by falling down of intoxicated persons represent 20% of traumas. During the last decade, there is a trend to increasing use of psychogenic substances/drugs, alcohol etc. [23,24]. Alcohol intoxication causes neurology injuries, may drive on violence and aggression and may make the person vulnerable to various injuries. Alcohol abuse may lead to decrease in self control and critical

attitude ability. Clinical practice shows that diagnostics is disturbed in these intoxicated patients, and in most cases patient does not co-operate. Possibility for vomiting is higher, which is extremely dangerous mainly in patients immobilized with cervical collar, as well as in inadequately monitoring of those patients, therefore these traumas are potentially critical for possible severe complications. It is considered that lack of enough control on alcohol sale is the main reason for decrease the age limit for its use. In our study, the most affected age group is between 20-39 - 17 patients (65.4%). With increase in age, as a general, alcohol-related traumas (AIRT) decrease. Free access to alcohol, its low price (many people can afford it) and favourable attitude to its consummation make it a social problem. Having in mind that alcohol decreases cognitive abilities to estimate the risk, decreases the ability to make rational decision, as well as bother physical ability to leave the accident place and makes self defence difficult, the big AIRT percentage in our study is no surprise. Relation between IPV (intrapersonal violence) and AIRT in MFA is well known and our study shows a higher regularity than expected - 42%. Daily alcohol use makes the person a possible victim of a thrash. Clinical material analysis shows that these injuries are obtained most often in strikes with fists, with legs, but also in hits with blunt and sharp objects. According to many studies, face is the most preferable zone in IPI after use of alcohol, whereas most of traumas are obtained on the street in front of catering establishments [23,24]. Domestic violence after use of alcohol should not be neglected as well, but because of evasive data by the patients, the exact number cannot be determined. Our study shows that RTA caused as a result of alcohol intoxicated motor vehicle drivers are extremely severe problem. Despite efforts of various organizations in campaigns against driving in intoxicated state, RTA, caused by alcohol intoxicated motor vehicle drivers take a major part of MFA traumas - 5.7%, according to our study. Regardless of the fact that many campaigns are performed for prevention of motor vehicle driving by intoxicated drivers, as well as for introduction of more strict sanctions for such drivers, success in this direction is not very encouraging.

#### 4. Conclusion

Clinical material analysis in our study is thoroughly performed in conformity with tasks and goal determined and gives us a reason to conclude that combined maxillofacial traumas are frequently observed health problem in contemporary society and sometimes these may complicate work in many maxillofacial surgery wards. We determined that CMFT represent 36,6% of all maxillofacial traumas and we emphasize the necessity of early interdisciplinary approach in diagnostics and preparation of therapeutic plan for these traumas.

#### Acronyms Used

ALRT- alcohol related trauma  
CMFT- combined maxillofacial trauma  
RTA- road traffic accident  
MFA-maxillofacial area  
CrT- cranial trauma

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