

# Approach for Initial Treatment of Combined Trauma Patients. Treatment Protocol in Maxillofacial Trauma Patients Admitted at Department of Maxillofacial Surgery

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**Abstract:** ***Background:** Correct therapeutic approach and algorithm of behaviour for diagnostics and treatment of combined traumas requires a high level of interdisciplinary cooperation and coordination. This leads to optimizing the therapeutic and diagnostic process and improves prognosis and outcome of patient's treatment. **Purpose:** To determine an approach for initial treatment of combined trauma patients and to present a treatment protocol in maxillofacial trauma(MFT) patients admitted at the maxillofacial surgery(MFS) wards. **Material 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. **Results:** The largest number of patients have been treated between the 3rd and 5th post trauma days - 38 (29.5%), equal number of patients between the 5th and 10th days - 33 (25.6%) and up to the third day - 33 (25.6%); after the 10th day - 25 patients (19.4%). 49,6% were treated under general anaesthesia, 43,4 %- under local anaesthesia and 7% under atar analgesia or sedation and local anaesthesia. Our study results indicate that regarding neurosurgical traumas, MFT are significantly rarely treated after the 10th day ( $x^2, p=0=021$ ). **Conclusion:** Maxillofacial surgeon has the extremely important and responsible role in diagnostics, planning and performing of therapy of CMFT patients. Early inclusion of MFS is important in multiple trauma patients and is essential for exact and correct diagnosis, as well as for adequate MFT treatment.*

**Keywords:** maxillofacial trauma, associated injuries, combined trauma, treatment

## 1. Introduction

MFT are an important group of injuries whose contemporary treatment requires a specialized treatment, innovative imaging diagnostics models, skilled and well trained personnel and specific devices. In the past 20 years, significant changes in treatment of traumatic patients occurred [1,3]. A large number of long-year defended principles are now in question [5,6,10]. In large trauma treatment during the last years, there is a development of ALTS, increase of trauma treatment medical team qualification, improvement in pre-hospital patient treatment, thanks to which patients are provided quality treatment. The most suitable time for performing a surgical intervention, i.e. for a complex restoration of facial skeleton in multiple injuries patients is still in question. In historical plan, MFT treatment has been postponed in time, sometimes with several weeks, until complete healing of intracranial injuries. Subsequently, guidelines for treatment of these traumas are developed and improved, whereas trends are for early overall treatment of facial traumas, often in the first several days or hours after the injury [14,16,17,19].

Early intervention in MFT treatment aims to improve prognosis. It is important to understand the MFA uniqueness both regarding the anatomy and because of proximity of neighbouring life-critical structures. Respiratory pathways passability, respiration and circulation may be affected during the trauma. Early diagnosis and treatment of life threatening statuses and affected vital structures improve prognosis significantly.

## Data analysis according to time from suffering a trauma to performing a definitive treatment

In our study, during result analysis, no significant differences are determined in CMFT patients distribution and time to their treatment ( $x^2, p=0.442$ ).

The results obtained by us in this study, indicate that the largest number of patients have been treated between the 3rd and 5th post trauma days - 38 (29.5%), equal number of patients between the 5th and 10th days - 33 (25.6%) and up to the third day - 33 (25.6%); after the 10th day - 25 patients (19.4%). Treatment time is determined by the patient's general status, whereas the estimation of anaesthesiologist-resuscitator is determinative regarding performing of general/atar/local anaesthesia (Table 1, Figure 1).

**Table 1:** Time to MFT treatment in combined traumas

Time to treatment	Patients		Level of significance
	Number	%	
<3 days	33	25.6	p=0.442
3-5 days	38	29.5	
5-10 days	33	25.6	
>10 days	25	19.4	

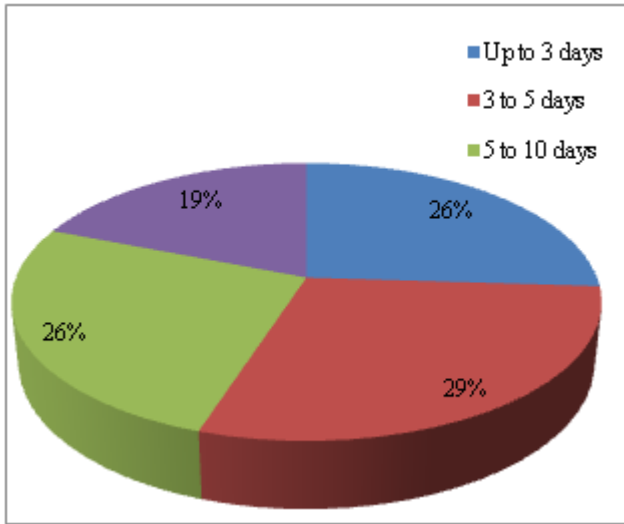


Figure 1: Time to MFT treatment

analgesia/sedation and local anaesthesia (x2, p<0.001) (Table 2).

Table 2: Pain relief method in CMFT patients (n=129)

Type of anaesthesia	Patients		Level of significance
	Number	%	
Local anaesthesia	56	43.4	p<0.001
Atar/sedation and local anaesthesia	9	7	
General anaesthesia	64	49.6	
Total number	129	100	

General anaesthesia is used as pain relieving method in orbit and orbital floor fractures (in 100% of cases), most often in upper jaw fractures (80%), in multiple MFT (78.3%) and in zygomaticbone fractures (68.9%) (Table 3, Figure 2).

Local anaesthesia as an independent method is most often used in dentoalveolar fractures (71.4%) and lower jaw fractures (56.7%).

Data analysis according to the type of anaesthesia used when performing a definitive treatment

When analyzing our study data, a significantly lower share is determined in CMFT cases that were pain relieved by atar

Atar analgesia / sedation and local anaesthesia are most often used in dentoalveolar fractures.

Table 3: Pain relief method according to the MFT type

Type of MFT	Type of anaesthesia			Total number of fractures /%	Level of significance
	Local anaesthesia Number/%	Atar/Sedation and local anaesthesia Number/%	General anaesthesia Number/%		
Upper jaw	3/20	-	12/80	15/100	0.020
Lower jaw	34/56.7	3/5	23/38.3	60/100	0.001
Zygomatic bone	10/22.2	4/8.9	31/68.9	45/100	0.001
Orbit	-	-	15/100	15/100	-
Nasal bones	10/35.7	3/10.7	15/53.6	28/100	0.020
Multiple MFT	4/17.4	1/4.3	18/78.3	23/100	0.001
Dentoalveolar	5/71.4	1/14.3	1/14.3	7/100	0.102

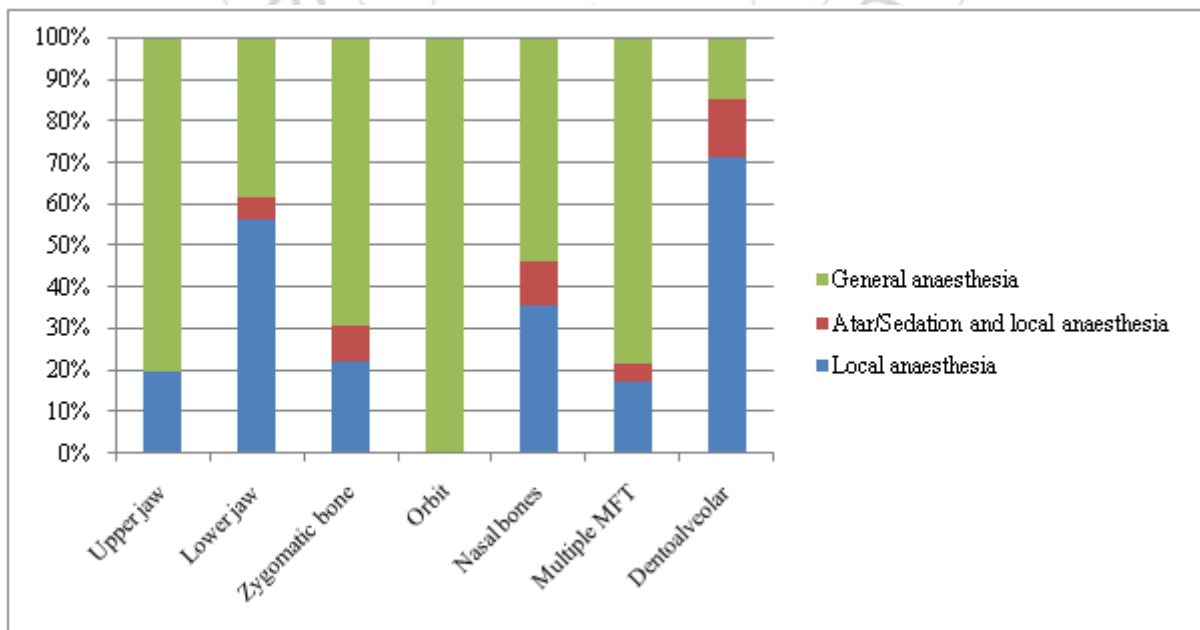


Figure 2: Pain relief method according to MFT type

**Data analysis regarding indexes of combined trauma /time to treatment**

Our study results indicate that regarding neurosurgical traumas, MFT are significantly rarely treated after the 10th day (x2, p=0=021). For example, these with more than one combined trauma, as well as polytrauma, are treated

between 5-10th day or after the 10th day, but patients number is not enough to obtain significant differences (Table 4, Figure 3).

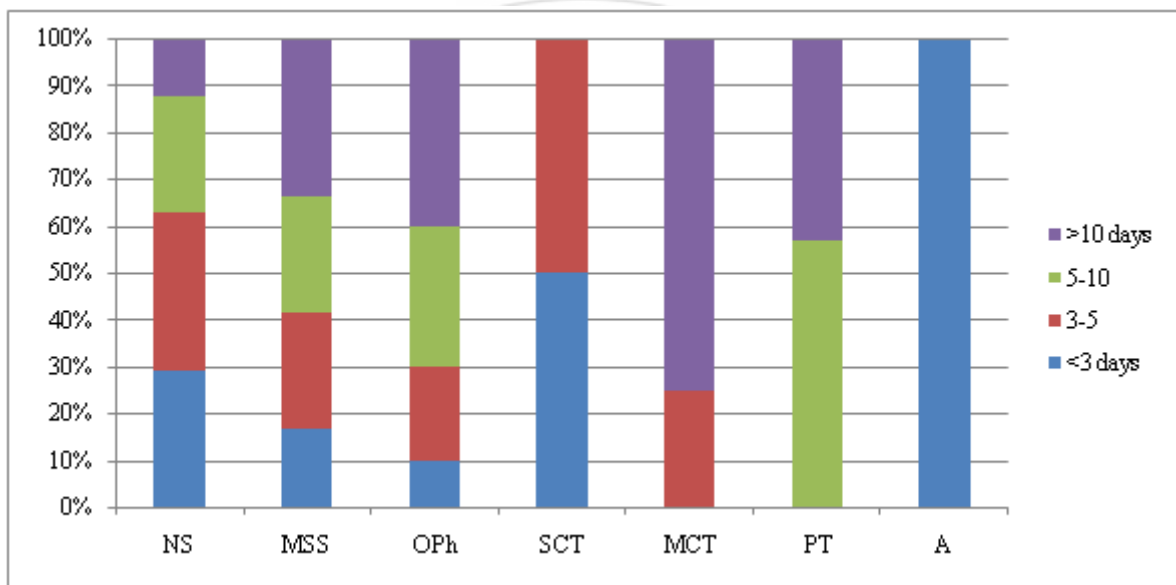
Therapeutic approach we use in CMFT and eye injuries is in conformity with the one used by most authors.

**Table 4:** Data analysis according to combined trauma / time to treatment

Time to treatment	Combined trauma								Total number
	NS	MSS	Oph	SCT	MCT	PT	ENT	A	
<3 days	27	2	1	1	0	0	1	1	33
3-5	31	3	2	1	1	0	0	0	38
5-10	23	3	3	0	0	4	0	0	33
>10 days	11	4	4	0	3	3	0	0	25
Total number	92	12	10	2	4	7	1	1	129
(p)	0.021	0.881	0.572	-	0.317	0.705	-	-	

Legend: NS - neurosurgery, MSS – muscular skeletal system, OPh - ophthalmology, SCT – spinal cord trauma,

MCT – more than one combined trauma, PT – polytrauma, ENT – ear-nose-throat, A - abdominal



**Figure 3:** Time to treatment according to CMFT type

Table 5 presents only neurosurgical combined traumas as these are most common in our study and there are most

patients, so it can be seen if the MFT type in neurosurgical traumas determines the treatment duration.

**Table 5:** Correlation analysis – time to treatment - MFT in neurosurgical combined traumas

Time to treatment	MFT that come together with neurosurgical combined trauma							
	Upper jaw	Lower jaw	Zygomatic bone	Orbit	Orbital floor	Nasal bones	Multiple MFT	Dentoalveolar
<3 days	0	11	6	0	0	3	5	2
3-5 days	0	12	5	2	0	7	4	1
5-10 days	1	10	6	2	0	1	3	0
>10 days	1	2	3	0	1	1	3	0

Dependences are determined between MFT treatment time and concomitant CrT – commotion, contusion or skull fracture. This study results show that in skull fracture, MFT treatment delays and is performed between the 5th and 10th day or is performed after the 10th day. In case of a contusion, treatment of MFT during the first three days is

also not common. While in commotion, MFT is treatment basically within the first 3 to 5 days and with less incidence between the 5th and 10th days and after the 10th day (Table 6).

**Table 6:** Data analysis according to time to MFT treatment depending on concomitant trauma

Time to treatment	Type of combined trauma				Level of significance
	Commotion	Contusion	Skull fracture	Other combined trauma	
<3 days	26	1	0	6	p<0.001
3-5 days	25	7	0	6	
5-10 days	15	9	3	6	
>10 days	6	7	4	8	
Total number	72	24	7	26	

In the analysed 129 CMFT patients, the following types of treatment were used:

- Standard tooth splints in 44 (34.1%) patients.
- Wire osteosynthesis in 24 (18.6%) patients.
- Plate osteosynthesis in 34 (26.4%) patients.
- Round ligatures and suspensive fixation in 11 (8.5%) patients.
- Reposition and anterior nasal tamponade in 23 (17.8%) patients.
- Plastics with frozen nasal cartilage in 10 (7.8%) patients.
- Closed fixation of zygomatic bone in 8 (6.2%) patients.

Table 7 provides information about MFT treatment – both for single (second table row for the relevant index) and for multiple MFT (first row) in CMFT. The specific type of treatment is presented, indicating if it was independent and if it was combined by other type of treatment to another facial trauma.

**Table 7:** Distribution of type of treatment depending on MFT – single or multiple

Type of CMFT	Patients	Treatment						
		STS/IMF Number/%	WBSO Number/%	PO Number/%	PMLSF Number/%	RANT Number/%	ApMP Number/%	ZFCR Number/%
Upper jaw	15	3 20	2 13.3	8 53.3	8 53.3	2 13.3	2 13.3	-
	3	2 66.7	-	-	3 100.0	-	-	-
Lower jaw	60	32 53.3	8 13.3	16 26.7	8 13.3	4 6.7	1 1.7	1 1.7
	48	30 62.5	7 14.6	9 18.8	3 6.3	-	-	-
Zygomatic bone	45	6 13.3	14 31.1	17 37.8	3 6.7	8 17.8	6 13.3	8 17.8
	25	-	12 48.0	8 32.0	-	1 4.0	-	6 24.0
Orbit	15	-	2 13.3	8 53.3	-	1 6.7	9 60.0	-
	13	-	2 15.4	6 46.2	-	-	7 53.8	-
Nasal bones	28	4 14.3	3 10.7	6 21.4	3 10.7	22 78.6	3 10.7	2 7.1
	12	-	-	-	-	12 100.0	-	-
Dentoalveolar	7	6 85.7	-	1 14.3	-	1 14.3	-	1 14.3
	4	4 100.0	-	-	-	-	-	-

Legend: STS/IMF – standard tooth splint / intermaxillary fixation; WBSO – wire bone suture osteosynthesis; PO – plate osteosynthesis; PMLSF – perimaxillary ligatures and suspensive fixation; RANT – reposition and anterior nasal tamponade; ApMP – Alopastic material plastics; ZFCR – zygomatic fracture closed reposition.

Basing on bibliographic data and our collective clinical experience, we determine that in CMFT treatment, it is possible a large number of clinical dilemmas to arise and must be discussed.

Advanced Trauma Life Support is determined as golden standard and is based on well known principles, but strict adherence to protocol may have its inconvenience in present

of concomitant MFT. Clinical dilemmas may arise during every MFT treatment – small or large, and oral surgeon and MFS must be aware about that possibility, whereas approach in each case is individual and differentiated.

Clinical material analysis in this study indicates that the advantage of multidisciplinary team of specialists availability is in creating of coordinated protocols during the mutual work, as well as more neat and logical approach in these patients treatment. When providing a specialized medical aid to traumatic patients, it is reasonable CMFT treatment to be presented as follows (Figure 21):

## Initial therapeutic approach in CMFT patients

**1. Immediate** – in significant haemorrhage and soft tissues injury with lacerations and defect, in open polyfragmented upper and lower jaw fracture, in optical nerve compression. Haemostasis and suture of soft tissues is applied, if possible – a temporary fragments immobilisation.

**2. Primary treatment** – it is applied in open and closed MFT and a surgery is performed until the 24th post trauma hour and stabilized general status of the patient.

- If the patient is steady in GCS monitoring.

- In cases that CT examination does not indicate worsening (includes open and closed fractures with/without frontobasal and cerebral injuries and open subcranial injuries). A controlled ventilation is applied without significant hyperventilation during the surgical intervention in order to avoid cerebral oedema. Placing the patient in a position with raised to 30° head may be useful. 6-hour frame must be taken into account because of significant oedema potential of facial soft tissues, which may disturb significantly the surgical intervention. Mid-face subcranial fractures and lower jaw fractures with significant fragments dislocation and without significant brain trauma may be treated within 12-24 hours after the trauma.

Contraindications for a selective primary treatment may be cardiorespiratory instability, coagulopathy, as well as other severe medical contraindications for a surgical treatment.

### 3. Postponed primary treatment

Multiple severe traumas patients (abdominal, thoracic, MSS), including with severe head trauma (GCS<8) and increased intracranial pressure, are not to be operated before intracranial pressure to be normalized and stabilized, as well as patient's general status to be stabilised. Medially severe head trauma patients (GCS 13-9) are operated after normalization and stabilizing of neurology status.

Postponed primary MFF treatment, combined with cerebral pathology, must be postponed with 5 to 10 days. Intracranial pressure, cerebral oxygenation and cerebral vascular autoregulation must be restored and steady. Presence of significant local contusion focus in brain also requires postponement of surgical treatment, in order to avoid secondary brain oedema and haemorrhage.

### 4. Secondary treatment

Includes a complex of injuries (thoracic, abdominal, spinal cord injury, MSS), that require surgical intervention postponement with more than 10 days because of the fact that patient's stabilization may take more time. Delay in treatment is connected to technical difficulties in fragment repositioning, as well as with immunosuppression between 11th and 21st day.(19)

Combined traumas treatment is risky, so that time of surgery and technique must be précised individually for each clinical case. It is possible and advisable to create multidisciplinary teams to treat different traumas in one surgical time. Thus time for hospital treatment is shortened and economic losses are reduced.

## Therapeutic protocol in MFT patients, admitted at the MFS wards

Patients with suspected or determined MF fracture may turn directly to MFS for treatment. Under these circumstances, other anatomic body parts injuries may be omitted and therefore an adequate consultation with specialists of adjacent specialists is necessary. Until determining of clear, based on facts recommendations, clinical approach must be based on knowledge of physiology, logics and collective experience gathered.

In providing a specialized medical aid to traumatic patients on grounds of own results analysis and their adaptation to ATLS“golden standard”, it is required the CMFT treatment to be presented as a several steps protocol for optimization of work in MFS wards (13,18):

- 1) Stabilising of the patient – per ATLS (patients with steady haemodynamics – no need of vasoactive or inotropic medicines, without presence of hypoxemia or hypercapnia, lactate serum levels <2.5 mmol/l, normal coagulation status, normothermia, normal urine excretion (>1 ml/kg/h).
- 2) Injuries identification.
- 3) Performing of imaging diagnostics (radiography / CT) and preparation, if possible and if necessary, of laboratory models (including stereo litographic models).
- 4) Appointing of consultations with relevant specialists.
- 5) Soft tissues processing and obtaining material for microbiologic examination per indications.
- 6) Temporary immobilization of bone fragments.
- 7) Preparing a preoperative plan and choosing an approach.
- 8) Fragments repositioning and fragments and soft tissues restoration.
- 9) When necessary, performing of a secondary reconstruction – placing of implants, contour plastics, cicatrices correction, vestibuloplasty.

Therapeutic approach in CMFT is expressed in achieving of balance and MFT treatment to be performed in stabilized patient's general status. Detailed knowing of MFA anatomy allows to perform a systemic facial trauma evaluation, as well as determining of its type and severity. Treatment is aimed to restore and provide normal bone and soft tissue anatomy in MFA in the same surgical time and to provide prevention of secondary deformations development.

Right anatomical restoration is of extreme importance in MFT treatment, whereas its change may cause functional and aesthetic disturbances: diplopia, enophthalm, ptosis, displacement of medial and lateral cantus, lacrimal system injury, nasal respiration disturbance, facial asymmetry. Facial injuries in patient with concomitant injuries may be of various skeletal injury severity. The aim is to achieve as full as possible restoration within a single stage, having in mind the patient's age and status, and also the fact that in massive admission of patients, sometimes intervention is segmented or limited to the most important. In these cases, secondary reconstruction is performed. It is performed not earlier than 6 months post trauma, after stabilizing of the patient. Modern trends are directed to performing a surgical intervention within one surgical time, performed by a multidisciplinary team, during which all surgeries the patient needs to be performed. Basic principles of treatment are

performed – Reposition anatomicae restitutio functionalis, during which facial harmony is restored. Thus, disability time is reduced, which is economically beneficial. In all cases, the problem with time for surgical processing is individually estimated. It is accepted that in liquorrhea, optimal time is from the second to the fourth posttraumatic day. When making a decision for fragments repositioning and fixation in MF fractures, before elapsing the time for movement of patients, time for healing of separated facial and maxillary bones (possibilities for complications as a result of untimely fragments reposition and fixation) must be taken into account. Lack of starting points in anatomic reposition is a large problem in massive MFT. Initial step in restoration is choosing of adequate approach to provide disclosure of fracture line, to achieve a good perspicuity and visibility, in which the fragments dislocation degree to be evaluated, as well as to see all fragmented and dislocated bone fragments. This topic is still debated, whereas choice of approach depends on particular clinical case and of surgeon's preferences. Failures in completing this step in treatment are expressed in inaccurate fragments repositioning and fixation and subsequent deformations. Final result of MFA fractures treatment is determined by achieving of premorbid facial morphology. Yet it is possible to get disproportions and asymmetries despite the precise facial skeleton reconstruction. When good reposition and steady fragments fixation is achieved, soft tissues affected by trauma or by surgical approach, must be restored in order to prevent subsequently secondary deformations. This imposes the use of various allo- and autotransplants for corrective plastics in nasoethmoidal area, for medial and lateral canthoplastics, for subperiosteal repeated malar soft tissues lifting, as well as for correction of orbital floor.

Adoption of optimum therapeutic tactics regarding MFT is as important as regarding the combined trauma. Underestimation or neglecting of requirement to MFT treatment are inadmissible. They lead to irreparable functional and anatomic deviations as a result of untimely and inadequate treatment.

Decisions made are based on clinical experience, on knowledge, as well as on the analysis of favour/risk and taken together, these are of great importance for further treatment.

## 2. Discussion

According to bibliographic data, trauma is the most common reason for lethal outcome in patients under 40 years of age. Injuries are among leading reasons for reducing or loss of ability to work for a certain period of time to the greater extent compared to cardiovascular diseases and oncology diseases taken together. Most of CMFT patient get disabled for a different period of time as a result of injury, as well as problems with vision, with sense of smell, with masticating, post traumatic cerebraesthesia etc.

Epidemiology studies vary depending on geographic region, of population density, of cultural differences, of social-economic status, of local legislation, of time for performing the study.

From June, 2005, to December, 2011, 352 traumatic patients have passed through the MFS Ward at the St. Anna University Multi disciplinary Active Treatment Hospital, of which 129 with a combined trauma (36.6%). This incidence is higher than in the Thoren's study [36] - 25.2%, Gassner's study [15] - 19.6%, Lim's study [27] - 11.3%, and is lower compared to other studies – Gwyn [19] - 51.6%.

This study, as well as most of other studies [1,2,4,5,10,12,14,15,16,17,19,35], shows that neurosurgical combined traumas have the highest relevant share (71.3%), that vary from commotion to depression skull fracture. It was determined that SCT, ENT and abdominal traumas are the most rare (1.6%, 0.8%, 0.8%, respectively), whereas difference is statistically significant ( $x^2$ ,  $p < 0.001$ ).

In the patients studied by Down et al. [12], the most common combined trauma, which comes close to this study results, is head trauma - 89 patients (82%). Kruger & Schilli [26] inform about incidence of 22% in combined MFT and CrT patients, which is approximately the same as in other studies (Paschke & Berz (1961), Muller (1969), Deutchlander, Wolff at al. (1976); only Van Hoof et al. (1977) indicate higher incidence – every second MFF patient has a head trauma.

Brain traumas incidence (especially light traumas) most probably is higher than the results stated in some studies according to bibliography [26]. Kloss et al. [25] indicate that during a CT examination, in 3% of facial skeleton fractures patients with 15 points per GCS and lack of neurology symptoms, which most probably would never pass a CT examination of brain, intracranial haemorrhage is determined. In addition, studies prove that injuries are observed in 50% of patients with present light brain trauma (GCS - 13 to 15) 1 year after the trauma [7,13,15]. One basic rule must be applied: if there is a maxillofacial fracture, the presumption is for presence of brain trauma until the opposite is proven [21,22,24,25,28,36].

The idea if early overall patient treatment is necessary, is more and more discussed [6,11,13,16,17] – once resuscitated, patient is transported from the emergency ward to theatre for immediate, overall and definitive treatment, or if other approach should be preferred [13] – after patient's resuscitation and stabilizing of hemodynamics (in a theatre, if necessary), to be moved to an intensive care ward as quick as possible, whereas the goal is definitive restoration to be performed subsequently, after improvement of general status. In this case, oedemas decrease, a re-evaluation can be performed and surgical intervention to be planned, as well as patient's information consent to be obtained. It is possible additional imaging examinations to be performed (stereo lithographic models to be made), individual splints to be prepared, more adequate evaluation to be performed and patient's treatment to be planned better. As temporary immobilization means, various wire ligatures, splints and own prostheses can be used and if there are no contraindications, intermaxillar fixation to be performed [13]. Thus blood loss and pain are decreased, patient's comfort improves (food and beverages administration), risk of infection ascending intracranially is reduced, as well as risk for liquor fistulae appearance [3, 6]. In some patients,

this can be used as a definitive treatment, while in others, subsequent, adequate for the particular case treatment must be performed. External fixing devices are not so often used as 30 years ago, but are very effective in some cases in multiple body injuries patients or if there are no other immobilization means, especially in transferring the patient to the emergency centre. In firearm injuries or in other cases of contaminated wounds, this method provides to a large extent a good temporary immobilization for a longer period of time, while contaminated wounds heal. Extraoral fixators are useful in providing a place (a space) and orientation in continuity in defect fractures [27]. Even usual approach in critical traumatic patients represents a challenge for clinical and experimental work [16,17]. There is also a trend, that a wide approach is used in complex cases, whereas there is a possibility for a precise anatomic reposition and if necessary – bone transplantation [17].

By some opinions, the idea for early and overall MFT treatment is defended [3,8,16,18,29,30,31,33], often in the first several days, and in some cases – during the first post trauma hours. A large part of articles state that in this approach, results are better, from the point of view of function and aesthetics, compared to waiting for several weeks before MFT restoration. Some injuries, such as contaminated wounds and persisting bleeding, for example, require an urgent intervention – if possible during the first several hours, having in mind the particular circumstances and limitations – initially, wound cleaning and haemostasis may be performed, followed by thorough treatment. In bibliography, there are opinions regarding MFT treatment, supporting early and one-stage fractured bones restoration. In the ideal case, surgical intervention must be performed 24-48 hours after the injury or as early as possible, when the patient's status allows that [17].

Optimum time for definitive surgical MFT (fractures) treatment is still in question and is individually decided in every separate case, and depends on available hospital resources, on clinical experience, on other injuries presence, as well as on necessity for transfer to the respective hospital center.

If, in a combined MFT and eye trauma (ET) trauma, there is no neurosurgical or other general problem (disturbed respiration, bleeding, shock etc.), which may danger the patient's life, eye trauma treatment is leading. Next follow orbit, eyelids, lacrimal apparatus and facial injuries. This is especially important in light eye traumas, where emergency is greater. On the contrary, in a severe eye trauma, in which functional prognosis is doubtful, eye trauma urgency treatment is smaller. In all cases, during the surgical treatment, it is necessary to work maximally atraumatically and carefully, as some unnecessary actions may harm the final result. In particular, urgent enucleation should be avoided even in cases in which functional and anatomic eye restoration is doubtful. Some authors consider that, if required, it is better to perform enucleation on a later stage, when the patient is psychically prepared to accept such a surgery, still more that the initial prognosis estimation is sometimes quite vague. In our study, definitive loss of vision following the trauma was determined in three of patients (7.8 %).

Optical nerve traumatic neuropathy requires an urgent consultation by an ophthalmologist right after recognized. Treatment may be surgical and medicated. Medicated treatment aims to reduce oedema and inflammation leading to ischemia [31]. Perry et al. [31] indicate two medicated therapy regimens. According to the first, steroids are applied until the 8th post trauma hour. Treatment is started with Methylprednisolone i.v., 30mg/kg for 30 minutes, followed by 15mg/kg every 6 hours during the first 2 days. The second regimen of steroids administration effect is also clinically proven – decreasing oral Prednisolone administration - 80, 60, 40, 20 (each dose is administered for 3 days) in cases, when the patient is able to administer oral medicines. Surgical approach is disputable and according to Perry et al. [31] is applied in cases when good effect cannot be achieved using steroids. Surgical approach includes transthemoidal, transcranial approach or by lateral orbitotomy and depends on surgeon's preferences, on circumstances and on each patient's individual characteristics.

Therapeutic approach depends on the fact if it refers to an open or closed bulb trauma. Analgetics (pain killers), antiemetic medicines are applied, TT is applied (tetanus toxoid) and eye bandage. Primary surgical treatment in open traumas is performed under a general anaesthesia as quick as possible (within 24 hours after the trauma). If there are foreign bodies, they are removed. Venous antibiotics are applied - Ciprofloxacin or a combination of Vancomycin and Ceftazidime to reduce the endophthalmitis risk. Patient's status is dynamically monitored because of the risk of endophthalmitis, glaucoma, retinal detachment, cataract.

Only if there is no disturbed bulb mobility, dislocation and/or enophthalm and fracture, and cannot be proven by radiography, the tactics "wait and monitor" is accepted [31].

The CMFT and ET treatment must comply with the following basic requirements [31], to which we kept during the CMFT and eye injuries patients treatment:

- a) Fragments reposition and fixation.
- b) Restoration of medial and lateral cantus.
- c) Revision and restoration of medial and lower orbital floor and diplopia correction.
- d) Nasolacrimal system restoration.
- e) Soft tissue and bone defects restoration.

Treatment must be directed to simultaneous fulfilment of all basic treatment requirements. Although undesired, sometimes second injuries reconstruction is necessary. In these cases, soft tissue deformations may occur with cicatrices or tissue defects, orbital floor dislocation, fragmenting and incorrect growing of canthal ligaments, eye motion muscles problems, vision disturbance, bulb dislocation and liquor fistula.

When determining the term for definitive MFT treatment, combined with NS trauma, the neurosurgeon and anaesthesiologist opinion is crucial. Flierl et al. [13] consider that choosing the ideal time for a definitive fractures treatment in head trauma patients is of primary importance in order to avoid pernicious impact of second hit

in brain trauma. Choosing a "safe" treatment in therapeutic strategy in combined trauma patients (including cranial trauma (CrT)) can be very complicated. Authors indicate that hypoxemia and hypotension, the „lethal duo in CrT" must in all cases be avoided, as these can cause again posttraumatic cerebral oedema that may have pernicious consequences for the patient. Adequate oxygen supply, correct fluid resuscitation and maintenance of cerebral perfusion pressure over 70 mmHg are of extreme importance [13]. Stahel, Smith & Moore [34] consider that patient is subject to a definitive treatment in case of the following achieved final post resuscitation results: steady haemodynamics, without need of vasoactive or inotropic medicines, without presence of hypoxemia or hypercapnia, lactates serum levels <2.5 mmol/l, normal coagulation status, normothermy, normal urine excretion (>1 ml/kg/h). These indexes are usually achieved between 5th and 10th days post injury (surgical window) and required results are achieved after substitution of temporary fixation with a permanent [13].

The experience has indicated that it is much better to wait the patient general status improvement and only then to undertake surgical intervention using the most suitable surgical technique – as reconstructive as possible. This strategy was accepted in treatment of combined MFT. Continuous postponing of facial trauma surgical processing is also considered wrong, including in severe CrT. The point is that facial skeleton bone fragments mobility deepens the shock and brain oedema. Besides, non repositioned and unfixated fragments leave the door open for infection ascending. Therefore the primary task that must solve treatment is preventing the ascending infection by restoring the barrier integrity between brain and facial skull. Some authors consider that such threat exists not only in presence but in absence of a direct relation between facial trauma and intracranial space. This threat increases also because of the fact that determining of injury in depth is difficult, especially right after bringing the patient at the hospital. Clinical signs of rhinorrhea in continuous bleeding are sometimes unsure, and radiography, including CT in restless patient almost never can be explicit. Therefore, when there are no confirmed data for barrier fracture between brain and facial skull, in severe fragmented fractures in this area, it always must be admitted injury of deep structures. The most certain way for their diagnosing and preventing of ascending infection and meningitis and cerebral abscess development is surgical revision. This intervention is justified even in case no suspected injury is found, as a possibility for correct bone fragments reposition and fixation is created [3,17,30,31,32].

Our study results analysis indicates that late transfer of patients from peripheral hospitals is one of the reasons for untimely MFT treatment. Other reason for delay in treatment is waiting for general status stabilisation. Our data indicate that in 25 (19.4%) of examined patients, MFT surgical treatment is performed more than 10 days after obtaining the trauma. We have determined that omissions in treatment of patients admitted from other wards result from lack of interdisciplinary approach, lack of good communication between individual specialists and untimely MFT diagnosis.

In bibliography, various omissions in trauma diagnostics and treatment are described, whereas mainly the following are stated: delay in intubation, inadequate oxygen supply, unsuitable drugs administration, transfer without a suitable escort, not performed radiography of the thorax, not performed ultrasound examination of abdominal organs etc. [12].

Some authors states that some of patients examined by them have remained with permanent defect following postponement of treatment because of general status stabilization of delay in transportation of patient to a specialized MFS ward.[12,30,32]. In some cases, in CMFT patients, it is indicated facial trauma to be treated at the same surgical time with another trauma (abdominal, thoracic, of MSS, etc.) by different teams. Thus second general anaesthesia is avoided and early MFT treatment provides optimum cosmetic and functional result, as well as minimum social economic loses.

Regarding the MFT with Spinal cord trauma(SCT) frequencies, there are various data in bibliography – from 1 to 6% [30,32], but there are still doubts about the actual significant statistic and epidemiology connection between them [23], whereas our study results indicate that in 1.6%, a concomitant SCT was determined. This study results are similar to other studies [23,29], according to which these traumas percentage varies from 0.8 to 3.7%. In all traumatology patients, the hard cervical collar must be correctly placed, whereas this is particularly important in mandibular fracture patients, in order to prevent excessive compression and fragments dislocation. Besides, it is considered that rigid cervical collar may lead to increase of intracranial pressure in patients with severe CrT [23,32]. Therefore, every complain of pain in the neck must be carefully evaluated, as well as other symptoms for such injury, including anaesthesia of conductive type, extremely abdominal respiration, impossibility to control urination and defecation. The patient must be treated as having cervical spine injury, until this possibility is rejected. This is extremely important in patients in unconscious state, in which motions during examination may cause additional spinal cord injury. Profile radiography or CT of cervical spine must be performed as early as possible, according to some authors, before other graphies and before treatment of other injuries, except life threatening conditions [32]. Cracked voice, haemoptysis, emphysema, crepitations may indicate such trauma. After a careful collar removal (this is performed between „Airway" and „Breathing" as per the ATLS algorithm), magistral vessels, hyoid bone and larynx may be carefully palpated for traces of injury, as well as to look for oedema [29,30,32]. Grover &Antonyshyn [17] determine criteria for clinical exclusion of cervical trauma, which we consider extremely accurate, having in mind the mutual relation of SCT mainly with lower jaw fractures:

- 1) Patient in conscious, GCS 14 or 15.
- 2) Patient who has not used alcohol and is not intoxicated.
- 3) Lack of (painful) so called distracting traumas (long bones fractures, severe soft tissue damages etc.).
- 4) Lack of palpation painfulness, muscles rigidity, presence of deformations, traumatic oedema and soft tissue injuries.



Before removing cervical collar (it is very important in presence of mandibular fracture – poorly placed collar may lead to problems in respiration), the patient must not inform about pain in the area of neck or about painful “distracting trauma”, as well as before examination, there should be no peripheral neurology symptoms [32].

In this study, eye injuries as a concomitant trauma in CMFT are observed in 10 of patients examined by us (7.8%), whereas three of them have had penetrating bulb trauma, connected to a unilateral definitive loss of vision. Compared to other studies, according to which eye injuries, concomitant to MFF, vary from 3 to 67%, percentage is relatively low in our study (7.8%).

Having in mind relatively higher mid-face trauma incidence in this study and post operative complications prevention, we must pay attention to the fact that retrobulbarhaemorrhage may occur after a surgery for mid-face restoration. Tensed eye and dilated pupil are sometimes the only signs for retrobulbarhaemorrhage. In unclear clinical picture, a CT examination may be performed. In patients, where loss of vision is reversible and their general status allows treatment of retrobulbarhaemorrhage, a surgical intervention (lateral cantotomy) is performed, aiming at orbital decompression and retinal perfusion restoration. Preoperatively, high doses of intravenous steroids, Acetazolamide (250-500 mg) and Mannitol (1 g/kg) are administered, and this therapy is continued post operatively as well, until bulb pressure is reduced [30].

High CMFT and ET incidence is due to anatomical proximity between these two areas. Therefore, some authors [9,27,15,29] emphasizes that these are more common in mid-face traumas, which is confirmed by our results as well, and according to other authors – in upper face part traumas [36,12]. For the clinical practice, it is important to note the opinion of Grover & Antonyshyn [17], that during the following MFFs, optical nerve injury is more possible: maxilla fractures - Le Fort II and III, nasoethmoidal, nasofrontoethmoidal, zygomatic complex fractures, which is confirmed by our study as well, according to which ophthalmology combined traumas are most often observed in orbital floor fractures. These fractures may lead to reducing the orbit volume, to cause periorbital soft tissues ecchymoses or to affect optical canal and to cause a secondary optical nerve injury and blindness. This study results confirm the fact, that in these traumas, interdisciplinary approach is mandatory, regardless of trauma severity. To achieve good functional result, the urgency of ophthalmology aid and treatment is as bigger as eye injury is smaller.

Most often, CrT come together with lower jaw fractures in 40 patients (31%), of zygomatic bone in 32 patients (24.8%), and of nasal bones in 23 patients (17.8%). These results are similar to studies of Haug et al. [21], Down et al. [12] and Thoren et al. [36] and quite differ from the study of Gassner [15], according to which in these traumas, mid-face traumas prevail significantly - 71.5%, mandibular traumas - 24.3% and orbital and frontobasal traumas - 4.2%.

MFT are relatively common in polytrauma patients. It is very important to early include the maxillofacial surgeon in

status estimation and in treatment of these patients. According to some authors, 25% of all MFA multiple fractures patients are with polytrauma [20,22]. Thoren [36] indicates that 7.5% of examined patients present a polytrauma, and according to our study, these are 5.4%. Down et al. [12] conclude that 16% of polytrauma patients present significant MFI.

In polytrauma patients, omissions in early injury diagnostics is often observed, especially in uncooperative and intoxicated patients, as well as in patients in unconscious state.

To prevent omissions in diagnostics and to improve prognosis, in conformity with ATLS principles, overall patients examination is required, as well as early adequate consultations to relevant specialists, as well as dynamic monitoring and re-estimation of their status. (30,32,37,38)

High energy traumas are a reason for presence of more than one concomitant injury or polytrauma, as well as for multiple MFA fractures. Concomitant traumas must be suspected in all high energy traumas. According to Thoren et al. [36], concomitant trauma was diagnosed in three of 4 patients with trauma from falling down from a height, and in two of three patients suffered during RTA, which is close to our results. High incidence of concomitant traumas in high energy mechanisms of injury may be examined as a main reason for life threatening conditions.

**Conclusion:** Maxillofacial surgeon has the extremely important and responsible role in diagnostics, planning and performing of therapy of CMFT patients. Early inclusion of MFS is important in multiple trauma patients and is essential for exact and correct diagnosis, as well as for adequate MFT treatment. Thus sometimes performing of repeated imaging examination is not necessary. This also provides a “possible window” for CMFT treatment together with MSS trauma, with the abdominal trauma or together with head trauma.

Correct therapeutic approach and algorithm of behaviour for diagnostics and treatment of combined traumas requires a high level of interdisciplinary cooperation and coordination. This leads to optimizing the therapeutic and diagnostic process and improves prognosis and outcome of patient’s treatment.

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